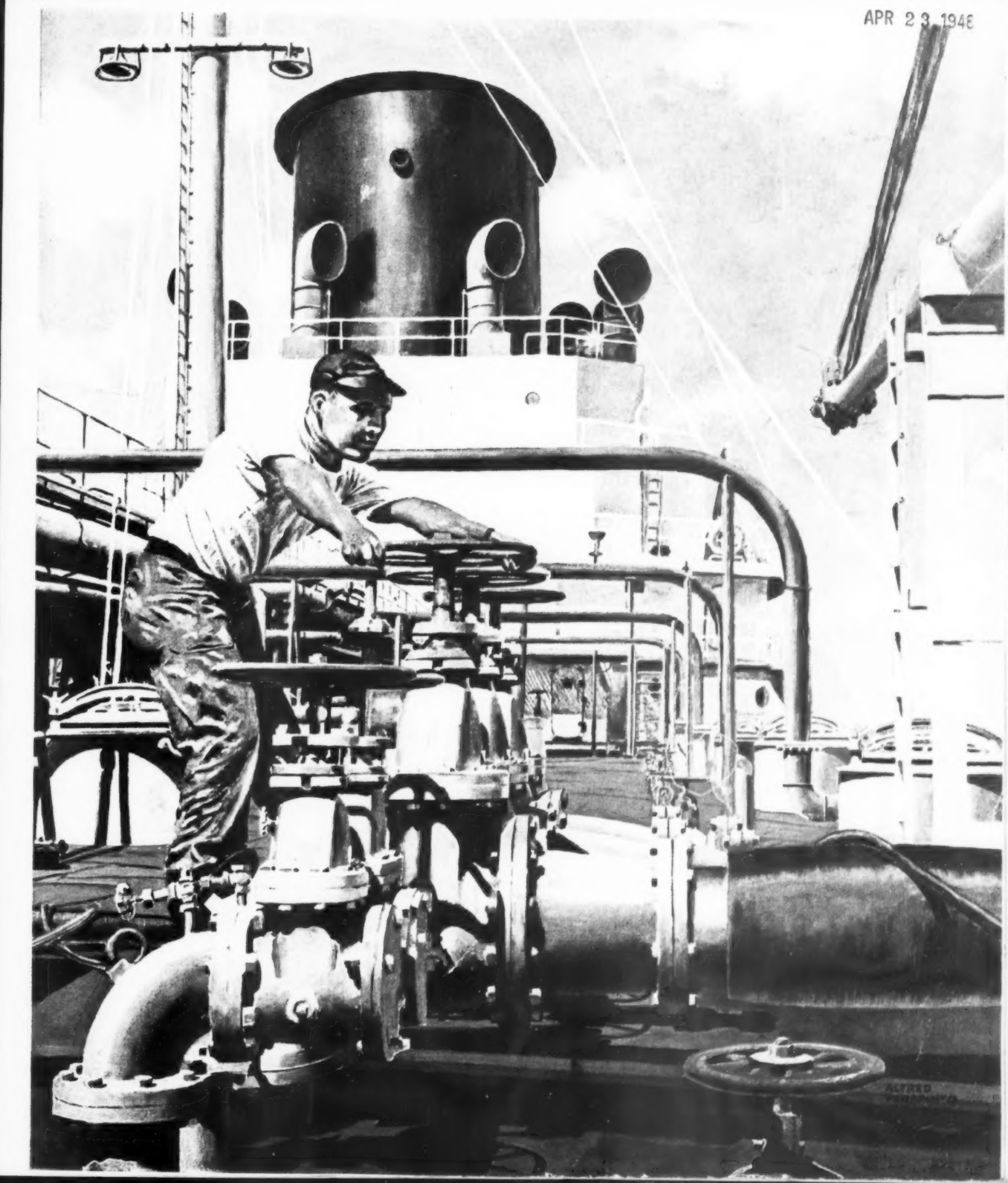
WORLD PETROLEUM

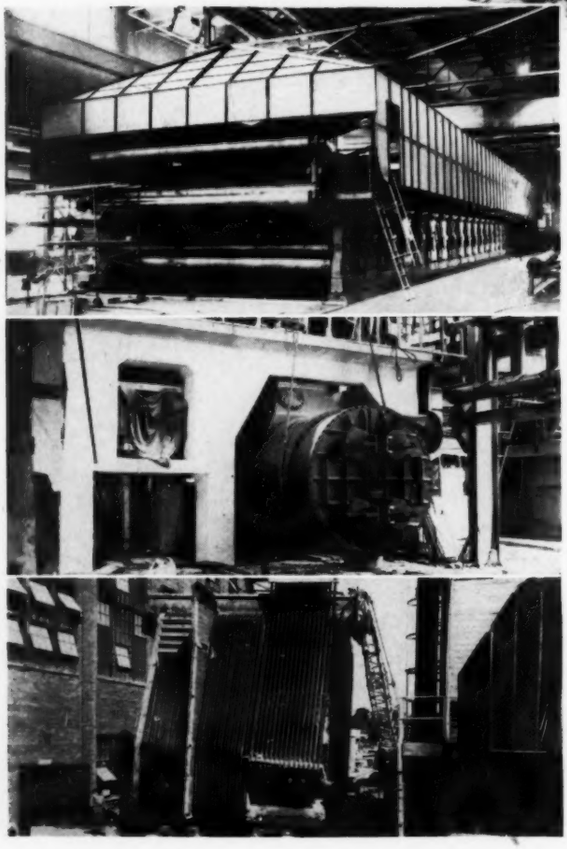
Science Library

APR 23 1948



FIVE DOLLARS PER YEAR FIFTY CENTS PER COPY

APRIL
1948



how to multiply a paper mill by 2

At the Southland Paper Mills at Lufkin, Texas, above, Brown & Root, Inc. was given the problem of doubling the newsprint output.

175 tons daily x 2
=350 tons daily

Doubling the production involved very substantial increases in power output, expansion of existing buildings, construction of new buildings, installation of new machinery, moving of old facilities, work of every type—and all the time manufacture of critical newsprint had to go on.

southland paper mills schedule uninterrupted

Our supervisors and crews have shown such fine teamwork with Southland's able personnel that production of Texas' greatest newsprint mill has continued at peak levels.

Bring your complicated expansion or new construction problems to Brown & Root, Inc., whose resources and experience in the Southwest are unsurpassed.

BROWN & ROOT Inc.

Box 2634 Houston, Texas

WORLD PETROLEUM

Founded by Russell Palmer

PUBLISHED BY MONA PALMER

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

E. W. Mayo
Editor

J. C. Chatfield
Managing Editor

Richard Sala
Art Director

SUBSCRIPTIONS

Annual subscription $5.00 (U. S.) postpaid
Single copies 50 cents

GENERAL OFFICES

2 West 45th Street, New York 19, N. Y.
(Tel. MUrray Hill 2-7333)

BRANCH OFFICES

LONDON: Georgian House, St. James, London S. W. I.

CHICAGO 1: W. R. Cotton, Mid-West Advertising Manager, 307 No. Michigan Ave., *(Tel. Franklin 2508)*

CLEVELAND 14: F. J. Enright, Cleveland Advertising Manager, Union Commerce Bldg., *(Tel. Main 5693)*

DETROIT 2: R. F. Pickrell, Michigan Manager, 314 Stephenson Bldg., *(Tel. Trinity 1-0709)*

LOS ANGELES 14: W. S. Johnson, Western Advertising Manager, 412 West 6th Street, *(Tel. Mutual 1391)*

NEW YORK 19: R. F. Scholbe, Eastern Advertising Manager, 2 West 45th Street, *(Tel. MUrray Hill 2-7333)*

TULSA 3: O. F. Cozier, Mid-Continent Advertising Manager, 515 McBirney Bldg., *(Tel. 4-5555)*

World Petroleum is published by Mona Palmer, Trustee under the will of Russell Palmer

CONTENTS

VOLUME 19 APRIL, 1948 NUMBER 4

Steel Oil Industry's Big Problem 51

USMC Completes Sale of Wartime Tanker Fleet 52

New Era Opens in Tanker Construction 54

Radar Aids Tanker Navigation 56

Growth of World Tanker Fleet 58

Financing Tomorrow's Oil 60

Diesels for Rotary Rigs in Deep Drilling 62

U. S. Oil Industry Needs Steel 67

Three Percent Rise in Known Reserves 68

Thermal-to-Suspensoil Conversion 69

Portable Electric Rig 72

Progress of Oil Field Unitization 76

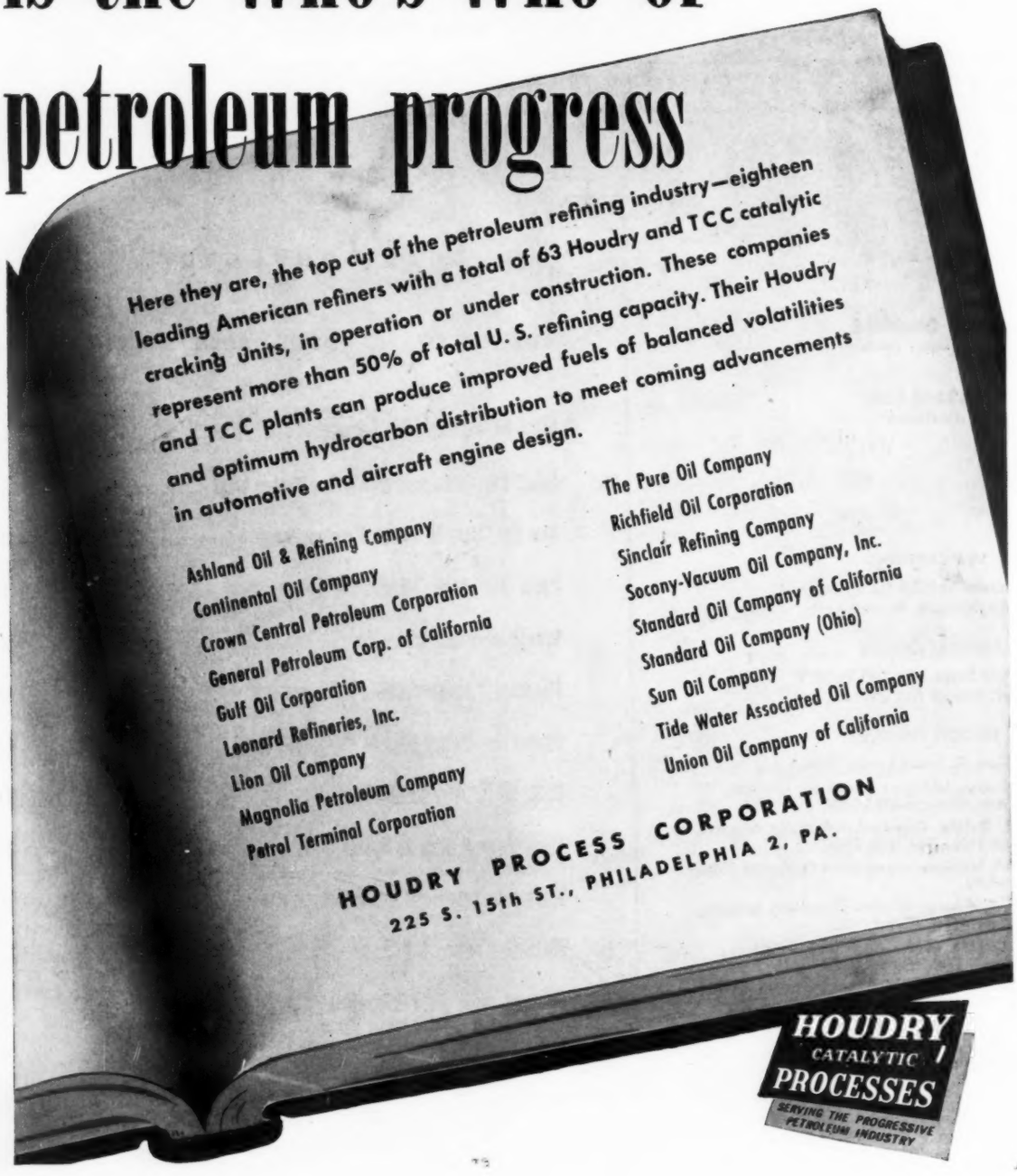
Radio Aids Huber Corp. 78

International Notes 80

Oil Company Changes 82

THIS MONTH'S COVER—Alfred Panepinto, staff artist of the Sun Oil Company's public relations department, painted the original from which this month's cover was reproduced. The painting was made aboard a Sun tanker at the Sun's Marcus Hook, Pa., refinery. The artist titled his painting: "End of the Voyage, Delivering the Cargo." Color plates courtesy The Sun Oil Co.

The list of Houdry licensees is the Who's Who of petroleum progress


Here they are, the top cut of the petroleum refining industry—eighteen leading American refiners with a total of 63 Houdry and TCC catalytic cracking units, in operation or under construction. These companies represent more than 50% of total U. S. refining capacity. Their Houdry and TCC plants can produce improved fuels of balanced volatilities and optimum hydrocarbon distribution to meet coming advancements in automotive and aircraft engine design.
Ashland Oil & Refining Company
Continental Oil Company
Crown Central Petroleum Corporation
General Petroleum Corp. of California
Gulf Oil Corporation
Leonard Refineries, Inc.
Lion Oil Company
Magnolia Petroleum Company
Petrol Terminal Corporation
The Pure Oil Company
Richfield Oil Corporation
Sinclair Refining Company
Socony-Vacuum Oil Company, Inc.
Standard Oil Company of California
Standard Oil Company (Ohio)
Sun Oil Company
Tide Water Associated Oil Company
Union Oil Company of California
HOUDRY PROCESS CORPORATION
225 S. 15th ST., PHILADELPHIA 2, PA.
HOUDRY
CATALYTIC
PROCESSES
SERVING THE PROGRESSIVE PETROLEUM INDUSTRY

EDITORIAL

STEEL IS OIL INDUSTRY'S BIG PROBLEM

WITH the United States virtually committed to support of the European Recovery Program, practical questions arise as to the implementation of that program. As is well known, petroleum products and petroleum industry equipment form one of the largest divisions among the supplies needed by the 16 countries participating in the plan. In the report of the Committee for European Economic Cooperation as revised for presentation to the United States, the quantity of imported crude and products necessary for these countries for the year 1948 was estimated at some 700,000 barrels daily rising to nearly a million barrels daily by 1950. Based on prices prevailing at the time of the report, which since then have risen substantially, it was estimated that expenditures for imported oil products would amount to $1,500 million in 1948 and would reach $1,735 million by 1951.

Requirements of "dollar" imports, comprising shipments from the United States and by American companies operating in other countries, were calculated as 530,000 barrels daily. Recognizing that the United States presumably would be a net importer of oil to cover its own requirements during the period contemplated by the European Recovery Program, the CEEC contemplated that the bulk of "dollar" petroleum supplies for the 16 countries would come from American operations in foreign countries, in large part from the Middle East. To make this possible it was pointed out that a great amount of equipment would be required for the laying of pipelines, the building of tankers, the erection of refineries and the provision of other necessary facilities.

It was estimated by the Committee that the cost of the equipment needed by the 16 European countries during the four-year period 1948-51 would be $1.9 billion dollars, of which these countries could provide roundly two-thirds, leaving $600 million dollars worth which could be supplied only by the United States. This calculation took no account of the equipment which American companies would require in order to expand their operations in the Middle East, nor did it include their requirements in other parts of the world such as South America and the Far East.

In the United States itself the needs of the oil industry for materials and equipment that will enable it to satisfy the rapid growth in domestic consumption of petroleum products have more than doubled since the last prewar period. As is well known, drilling operations and pipeline construction were limited in 1947 by the short supply of structural and tubular steel, while numerous projects for the erection or enlargement of refineries hod to be postponed because of inability to obtain early delivery of materials. The pressure upon the industry to enlarge its capacity is increasing, not subsiding.

Taking into account the world situation in all its aspects, it becomes evident, as has been pointed out in these pages on more than one occasion, that the problem of oil is in essence a problem of steel since steel is the main material component in all oil industry operations. The ability of oil producers and processors to fill worldwide demands for their products depends upon their success in obtaining adequate tonnages of steel.

A detailed study of the steel requirements of the American oil industry has just been completed by a special committee of the National Petroleum Council. The study relates specifically to the final three-quarters of the current year and the first three-quarters of 1949. On a yearly basis the requirements of the industry add up to a total of 10,381,000 tons. Adding to it the special requirements of the countries included in the European Recovery Program to which the United States is more or less committed, with some allowance for other countries dependent upon the United States for equipment urgently needed for their own oil industries, it appears that the aggregate quantity of steel that American companies will be asked to provide in 1948 and probably for each of the next several years will be something like 12,500,000 tons.

This figure is not directly comparable with statistics issued by the steel industry for the reason that some parts of the tonnage referred to, such as that for containers, for tank cars and tankers, are attributed in steel statistics to the container, railway and shipbuilding industries. Figures of the American Iron and Steel Institute show that the output of pipe and tubing, of which the oil industry is a main consumer though of course not the only one, reached six million tons in 1947, the highest record of any peacetime year. Total capacity of United States mills for the ingots from which products are rolled has been increased by about 3,000,000 tons to 95,000,000 within the past year. With pressing demands from all steel-using industries, however, and with the prospect of heavy requisitions by the government to expand its military strength, it will hardly be possible for the steel mills to provide anything like the quantity of material wanted. A downward revision of supplies that can be made available either to the domestic industry or the ERP program appears inevitable.

Photo by Eagle for Standard Oil Co. (N.J.)

USMC COMPLETES SALE OF WARTIME TANKER FLEET

SALE of all remaining government-owned, war built oil tankships has been approved by the United States Maritime Commission, and that agency expects to write off the tanker phase of its ship disposal program as completed within the next month. There may be a few tankers still in repair yards or completing terminal voyages after the first of April, but aside from that the sale and delivery program will be at an end.

Coincident with announcement of the Commission that it had completed arrangements for putting all of its commercially usable and idle tankers into operation, a top official of the agency expressed the belief that the oil transportation shortage was at an end for this season. Any oil shortage next winter probably will be due to a shortage of supply he opined.

"The hump in the transportation situation has been passed, as far as we can see from this end," he said. "There are plenty of privately-owned tankers now in service to move all available oil from the Gulf to the East Coast. The oil and tanker companies seem able to meet their commitments. There should be no further trouble this season. The situation next winter will depend largely on the available supply. That's the way it looks to us."

As a result of the brighter transportation picture, it is expected that purchasers of surplus T-2 tankships will be released from promises to keep warbuilt tankers in Atlantic Coast service until May 1. Recommendation to this effect was due to be presented to the five-man commission.

Foreign purchasers of some of the tankers have found it difficult to locate Caribbean cargoes to bring to the United States. Foreign flag vessels, under the law, are barred from trading between two united States ports, but they may bring cargoes from abroad to the United States. Also, the official pointed out, some oil companies which were allocated ships from the USMC operating fleet could not find cargoes at Gulf ports and turned the vessels back to the Commission. These conditions contributed to the recent East Coast shortage. The vessels that were turned back were reallocated to other buyers.

"It was a shortage of cargoes as well as shortage of tankers that caused the trouble this past winter," he said.

Nine T-2 tankers which previously approved buyers failed to take recently were reallocated for sale by the Commission to the following purchasers: Nautilus Steamship Corp., two tankers; Sword Line, Early-Walter, Inc., American Trading and Production, Trinidad Corp., Anchor Oil, American Viking Corp., and Sabine Transportation, one each.

Even though sufficient private tonnage now is available for domestic transportation, the Commission still has more requests for ships from its operating fleet than it can fill, the official said. This is because Commission rates are lower than charges made by private owners, although private carriers are not getting the same high single-voyage premiums they did a few weeks ago. He cited one private company which chartered a ship for one voyage late in February at only 75 percent above USMC rates. Before that, private owners had been asking and getting as much as 175 percent above the Commission level. Thus some Commission officials believe private owners will suffer hardships if they are held strictly to agreements to keep tankers bought from USMC in domestic service until May 1. Such purchasers can get high rates for their ships abroad this spring, it was said, although the foreign tanker market also is reported to have slipped somewhat.

The general agency operating authority, originally due to terminate February 29, has been extended by Congress for one year, or until March 1, 1949. In reporting passage for H. J. Res. 332, extending the authority, the House committee said:

"The committee, in making the extension, believes the Maritime Commission should make every effort to withdraw the government from the shipping business and sell as many ships as possible to private owners.

"The committee also is of the opinion that the transfer of ships to foreign nations, as has been suggested in connection with the proposed European Recovery Program, is wholly inadvisable. The committee feels that neither the Maritime Commission nor any other agency should attempt to charter, sell or transfer title to any person who is not a citizen of this country, nor to any foreign government." However, this applies largely to dry-cargo vessels rather than to tankers.

The government built 580 tankers for the wartime fleet. This included 481 T2-Se-A1 tankers, 62 Liberty tankers, 21 T-1 ships and 16 special types. The T-2 vessels included 51 which private companies helped build under the Merchant Marine Act of 1936. The variance in the number built and number sold result from the fact that some were lost during the war and a few were sold for scrap.

The final authorization of sale brings the total number sold to 544. All of these were T-2's except 91 in the other classifications.

American buyers purchased 321 T-2's with foreign buyers taking 132 of this type. Domestic

purchasers took all of the 54 Libertys, 16 specials and eight of the T-1's reported sold, while foreigners took 13 T-1's.

A breakdown of the 544 total sales has not been completed, but the following statistics are available on the first 466 tankers sold: of these, 390 were T-2's, 51 Libertys, seven T-3's, four T-2 specials, four privately built requisitioned tankers and 10 T-1's.

Non-citizen purchases totaled 133 T-2's and seven T-1's. American citizen buyers received approval for purchase of 257 T-2's, 51 Liberty types and 18 other types.

Of the group sold to citizens 186 T-2's were for operation under the United States flag and 71 for transfer to foreign registry. One T-1 was for foreign registry. All others went to United States citizens for U. S. flag operation. Status of the T-2's is as follows:

Total built		**481**
A. CTL/Lost		9
B. Sold under Merchant Marine Act 1936		51
C. Approved for sale, 1946 Act		390
(1) U.S. Citizens, U.S. flag	186[a]	
(2) U.S. Citizens transfer title and registry	66[b] [c]	
(3) U.S. Citizens transfer registry	5	
(4) Non-citizens	133[d] [e]	
D. Sold other authority		13
		463
Repair for operation Navy		10
Navy postwar fleet		1
Army bareboat		1
Lend Lease Russia		4
		16
Offered on bid basis		2
Remaining available		**0**

(a) 77 delivered
(b) Includes eight tankers approved for sale to Overseas Tankship Corp.
(c) 51 delivered
(d) 78 delivered
(e) Includes one tanker to Peru

Of the 100 T-2 tankers recently under consideration for sale foreign, 83 were sold and these plus the 50 purchased earlier brought the sales foreign to 133. The 83 vessels within the "not more than 100" group approved for sale will be taken from the Reserve Fleets and from operating status and will go to these countries as indicated:

Country	Operation	Layup	Total
United Kingdom	30	1	31
Turkey	—	1	1
France	6	5	11
Netherlands	2	2	4
Italy	6	10	16
Canada	2	2	4
Greece	3	4	7
Peru	—	1	1
Norway	—	6	6
South Africa	—	2	2
	49	34	83

During the past fall the Navy and Maritime Commission agreed to recondition from the reserve fleets 50 military type tankers to serve the Navy's essential needs. Of these, the Navy repaired 26 and the USMC 24. This work has been completed, and as the repaired boats went into Navy use, other tankers were released by the Navy and added to the reserve fleet for private use.

Although the whole sales program is reported as completed, some tankers remain in repair yards and may not be delivered until after April 1. As of this date there are 65 vessels in the operating fleet; all of these are sold and now are on terminal voyages. Some five T-2's, six Libertys and two other types now in the reserve fleet are yet to go into the repair yards prior to delivery to buyers.

T-1 tanker now in coastwise service of Sun Oil Co.

The T-2's average around 16,000 tons deadweight. The Libertys average around 10,000 tons.

Statutory sales price for the T-2's was $2,026,500 or 87½ percent of cost prewar. With a floor price of $1,500,000, sales price of these ships has averaged around $1,700,000.

Statutory sales price of the Liberty's was $639,000 with a floor of $544,506, and sales in this category have averaged merely the floor price.

The T-1's were sold at an average price of $887,000. Few of these were sold while T-2's were available.

Many domestic sales have been for cash, but some buyers paid one-fourth down with balance on terms. All foreign sales were for cash unless sales price was guaranteed by the foreign government.

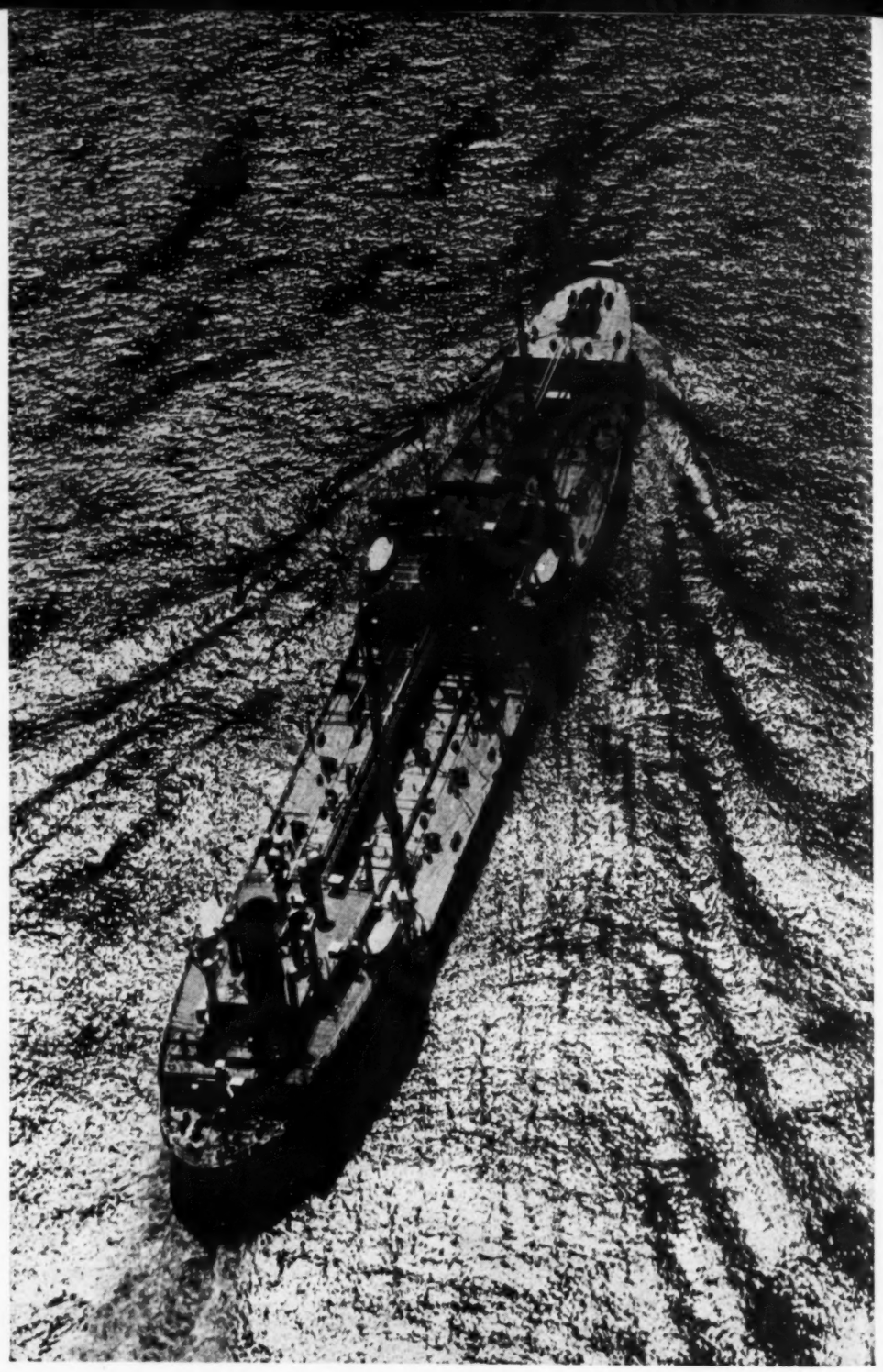
While all of the tankers owned by the Maritime Commission at the close of the war, aside from those assigned to the armed forces and the few consigned to the scrap heap as obsolete, have now been sold, published registry lists based upon 1947 reports still assign the ownership of a majority of these vessels to the Commission. Actual transfer of title was delayed in some instances because the ships were under charter for varying periods; others were in process of conversion of undergoing repairs and were not ready for delivery. According to these reports the number of ocean-tankers (2,000 tons or over) under private ownership was 310, while 462 were still accredited to the government agency. At the conclusion of the Commission's operations a full report will be made which will present details of ship sales and reveal their effect upon the world tanker situation.

T-2 tanker at Shell Oil Company's refinery dock at Houston, Texas. Shell photo.

NEW ERA OPENS IN TANKER CONSTRUCTION

AS late as September, 1947, one and a half million tons of fast modern tankships were laid up in the United States. Most of these were the celebrated T-2's built for the American government to supply the wartime needs of Allied armed forces. They had a speed of better than 15 knots and a carrying capacity of 140,000 barrels. Since that time these vessels have passed to new ownership, some to American citizens and others to foreign governments and companies, though many of them have not yet delivered to their purchasers.

Between August 1, 1946, and December 13, 1947, a total of 276 ocean tankers were sold by the U. S. Maritime Commission under authority granted by Congress. Of these 111 with an aggregate deadweight tonnage of 1,776,553 went to American purchasers and will remain under the United States flag, while 165 totalling 2,611,754 tons were sold to foreign interests or to American companies for registry under other flags. Since the first of the year as noted above, the remaining available tonnage has been sold.



Standard of California's tanker J. L. Hanna heading out to sea. ↑

Welding lines aboard a tanker under construction by Sun Shipbuilding and Drydock Co., Chester, Pa., Photo by Libsohn for Standard Oil Co. (N.J.) ↓

In view of this large addition to oil-carrying capacity, it is all the more noteworthy that the first months of 1948 should be marked by the opening of a new era of tanker construction. The reasons for this development are not far to seek. The extraordinary rise in consumption of petroleum products in the United States has been accompanied by an even greater proportional rise in other parts of the world. The situation prevailing during recent months, which led the American government to stipulate that tankers sold from its reserve fleet should be employed in

coastwise traffic, was due to an emergency which already has eased to an extent that has permitted suspension of the rule. Aside from the influence of weather extremities which operated in this case, however, there is no indication that the use of liquid fuels will not continue to expand at a rapid rate or that ocean transportation will not remain the most economical means of moving these products from the great producing areas along the Gulf to the great industrial districts of the East.

In international trade, water routes are changing and the volume of traffic over long-distance lines is increasing. Imports to the North American continent are destined to increase steadily and perhaps rapidly. There are definite indications that these import requirements will no longer be met entirely by shipments from the Caribbean area but that a growing proportion will be drawn from the Middle East. It is an accepted view that western Europe will draw most of its supplies from that region. Other markets, such as South Africa and Australasia which are fed with products moving over relatively long distances, are expanding their requirements rapidly. It is estimated that the deep water movement of petroleum, including coastwise traffic of the United States, increased five million tons between the last year preceding the commencement of the late war and 1947. Utilization of existing cargo capacity is held to be capable of handling the current volume of traffic but not of providing for anticipated growth or for the replacement of vessels that will become obsolete from year to year. Economists who venture to look into the future for another two decades foresee world consumption of petroleum rising to 12 million barrels daily with a doubling of present ocean tanker capacity.

A significant feature of the new program of tanker construction is the provision for higher speed and greater carrying capacity. This is especially pronounced in the vessels now being built in the United States, but the same trend is observable in Europe. It is in part an effort to counteract the rise in construction costs and costs of operation which have more than doubled since prewar days. It is also a recognition of the necessity for longer voyages and for the movement of oil in greater quantities. It is obvious that a vessel that can transport 200,000 barrels of oil between two ports in two-thirds the time required by a ship of half that capacity can do the job at a lower rate per barrel even though its own fuel consumption and other operating costs are higher. In the case of the vessels now going on the stocks the saving is estimated at roundly 20 percent.

A great advance over prewar standards was made in designing the T-2's that comprised the main part of the wartime tanker fleet. They combined an increase of 40 percent in capacity and nearly 50 percent in speed over the average prewar vessel. The American-built tankers for which orders have been placed since January 1 are slightly superior in speed to the T-2's, but have a cargo capacity 70 percent greater.

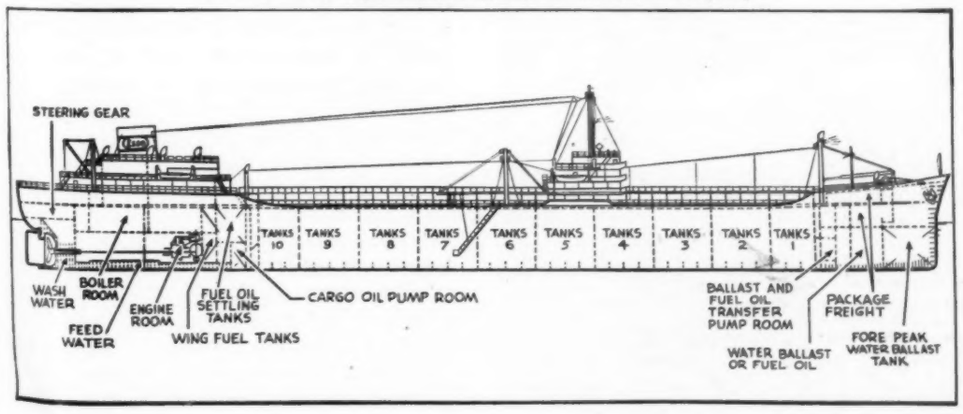
Fifteen of these super tankers are now on order for three American oil companies. They are of 16,750 tons gross and 26,000 tons deadweight each, will have a service speed of 16 knots and each will carry 228,000 barrels of oil. Their overall length will be 628 feet with 600 feet between perpendiculars. Moulded beam will be 82 feet six inches, and moulded depth to the upper deck 42 feet six inches. Their draft will be 31 feet six inches. As compared with the T-2's, they are 125 feet longer with a 12-foot greater beam and four feet greater depth, but their carrying capacity is 88,000 barrels more. It is notable that their draft is only one foot greater than that of the T-2's, enabling them to use practically any port that the T-2's can.

Hulls of the new vessels will be of steel welded and riveted construction. They will be of single deck type and will have single screws. Turbo-electric drive will be installed, with a high pressure, geared team turbine capable of developing 12,500 shaft horsepower at 112 rpm.

The design of the vessels and the salient features were decided upon after careful study and consultation by architects and engineers of the shipbuilding firms and the oil companies. They are believed to represent about the limit of economical size and capacity under present operating conditions or until improvements have been made in harbor and terminal facilities.

Each ship will carry a normal complement of about 50 crewmen who will be provided with the most modern quarters.

Profile of the four super tankers to be built for Standard Oil Co. (N.J.)



Of the fifteen tankers being built to these specifications, eleven are to be constructed by Sun Shipbuilding and Dry Dock Company at Chester, Pennsylvania. Seven of these are under order from Tankers Navigation Company for Socony-Vacuum Oil Company, two are for Standard Oil Co. (N. J.) and two are for Gulf Oil Corporation. Four others will be built by Newport News Shipbuilding and Dry Dock Company at Newport News, Virginia. Of these vessels three are scheduled for completion before the end of the current year and the others during 1949. Other large tankers under construction in American shipyards are four of 18,000 tons at Newport News for Greek interests and two of 30,000 tons each being built by Welding Shipyards at Norfolk, Virginia, for National Bulk Carriers. Other orders are pending.

Before World War II the tonnage of ocean tankers under the British flag was greater than that possessed by any other nation. The war took a toll of 215 tankships, over two million tons, and despite replacement by building and purchase amounting to 1,900,000 tons, the United Kingdom in 1947 was in second place with 21.6 percent of the world fleet, being far outdistanced by the huge building operations of the United States during the war period.

Although rationing of petroleum continued in force in Britain during 1947, imports increased during the year and will increase greatly whenever a free market is restored. The present fleet is inadequate for the nation's needs, and last year freight payments to foreign carriers were over ten million pounds ($42 million), but ship construction of all kinds proceeds slowly in British yards because of the scarcity of steel and lack of sufficient labor. At the present time British owners have an order or in course of construction 83 tankers of 1,060,000 tons deadweight, but a considerable number of these will be needed to replace vessels which are obsolescent.

Meanwhile British tanker owners are carrying on with difficulty. Freight rates are fixed by the government, and the maximum from the Persian Gulf to U. K. ports is 57/6 per ton ($11.50), while foreign flag tankers have been chartered for a series of voyages over the same route for 175 shillings or $35 per ton, over three times the official rate.

British shipping men are alive to the need of a much larger tanker fleet to take care of U. K. and colonial requirements, but as they view the situation, it will be a matter of several years under the most favorable conditions before this expansion can be accomplished.

Shipyards on the continent are reported to have between 60 and 70 tankers on the stocks, mostly in the Scandinavian countries. Prior to the war the Norwegians always had a large share of the oil-carrying trade. With their lower initial and operating costs they had a decided advantage in competing with British or American vessels. This they will still retain, and the high rates that have prevailed since the war serve as an inducement.

Radar scope of a Standard of California tanker entering San Francisco Bay superimposed on map of approaches to Golden Gate.

RADAR AIDS TANKER NAVIGATION

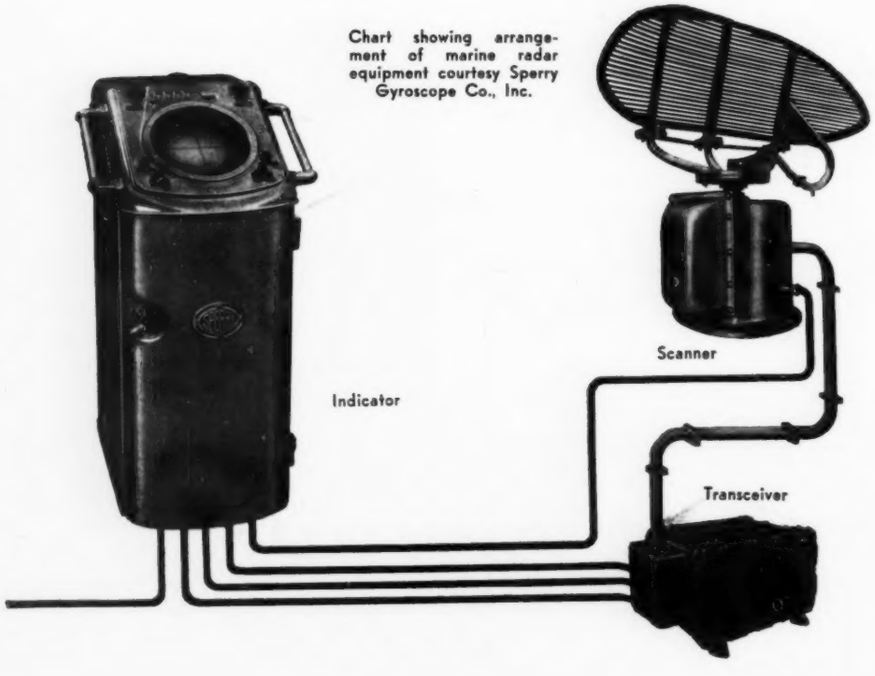


Chart showing arrangement of marine radar equipment courtesy Sperry Gyroscope Co., Inc.

USE of radar as a navigational aid was a development of World War II, and information concerning it was a closely-guarded military secret until the end of that conflict. So many marine men had the opportunity as members of the armed services to become familiar with the equipment, however, and to realize its value that demands for its installation on merchant vessels arose from many quarters as soon as the war ended. Commercial radio equipment companies immediately undertook studies to work out systems adapted to the special requirements of river, harbor and deepwater craft, with the result that installations on vessels of all these classes are multiplying rapidly. Radar is in fact coming to be accepted as being as much a part of the standard equipment of merchant ships as it is in the case of naval vessels.

It is perhaps unnecessary to explain that the three important functions of radar in the navigation of inland or ocean waters are to serve as an aid in piloting, as an indicator of position and as a preventer of collisions. A radar-equipped vessel can detect the presence of ships or other objects on its course under any weather conditions that

may prevail in ample time to avoir all danger of collision. It can determine its own position when approaching land or following a narrow channel. It can safely enter a harbor when fog or low visibility arising from any cause otherwise would compel it to anchor until a clear course was visible. Aside from its value in assuring safety, it is of first rate practical importance in time saving. This is a consideration of dollars and cents consequence in the operation of tankers, where every means of obviating slowdowns or speeding up turn-around at the end of voyages is eagerly welcomed.

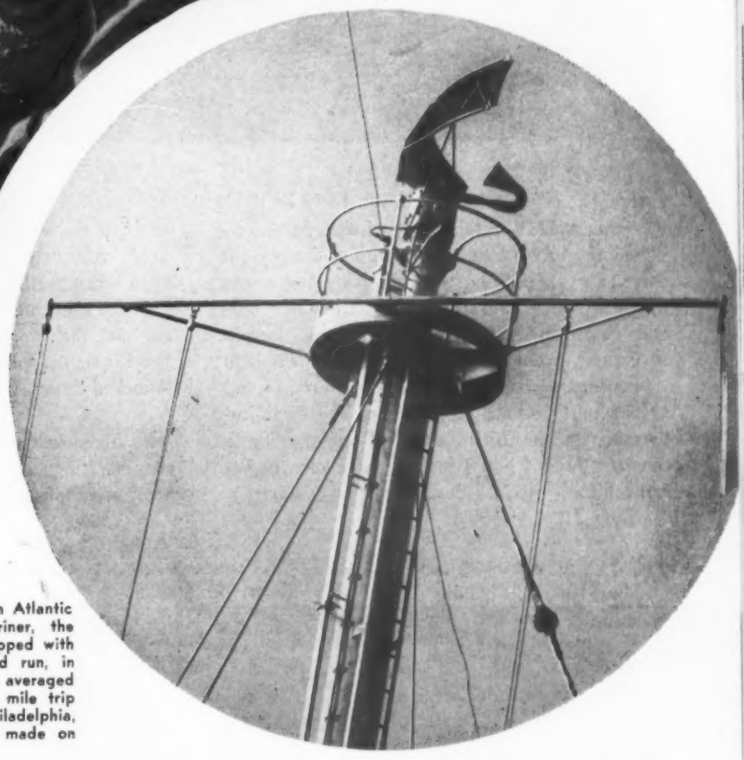
The operation of marine radar equipment is relatively simple. Essential parts of the equipment are a transceiver which transmits impulses to a scanner or screen and receives from it signals which it forwards to an indicator; the scanner which projects pulses into space and receives echoes from targets; the indicator which converts incoming signals into images that are shown on the viewing scope. To a layman the most remarkable of these is the indicator which displays images so clearly that the nature of the objects portrayed can usually be defined. Even the approach of a heavy storm cloud has been recorded on the scope.

Waves sent out by ships' radar are released in short bursts, called pulses, with intervening pauses sufficient for recording any response that may be received. Since the transmission is by micro-waves which travel with the speed of light, the operation is practically continuous. The waves are not broadcast as in ordinary radio but are directed by a band covering a path of varying width according to the angle that the ship's navigator desires to cover. Likewise the range can be regulated to suit operating conditions. For ocean navigation it usually is fixed at 50 miles, while for craft engaged in coast-wise or harbor work, it may be less than five miles.

The first seagoing tanker equipped with radar was the "Atlantic Mariner" of Atlantic Refining company, which was launched early in 1946. It was followed shortly by the "R. G. Follis" of Standard Oil Company of California which went off the ways on October 21 of that year. Since then each of the seagoing vessels of California Standard has been equipped wtih radar, and installations have been made on a number of tankers of other companies including five of Socony-Vacuum's fleet.

Early in March it was announced by Standard Oil Company (N. J.) that arrangements had been completed for placing radar on 40 of its tankers, 20 to be equipped by Sperry Gyroscope Company and 20 by Radiomarine Corporation of America. The sets operate on a frequency band of 9320-9500 megacycles (3-centimeter wave length) and are fitted with 12-inch viewing screens. Completion of this order, it is stated, will make Jersey Standard the largest user of commercial marine radar in the world. Tests of various types of instruments are continuing, and it is the purpose of the company ultimately to install radar on all 90 tankers of its fleet.

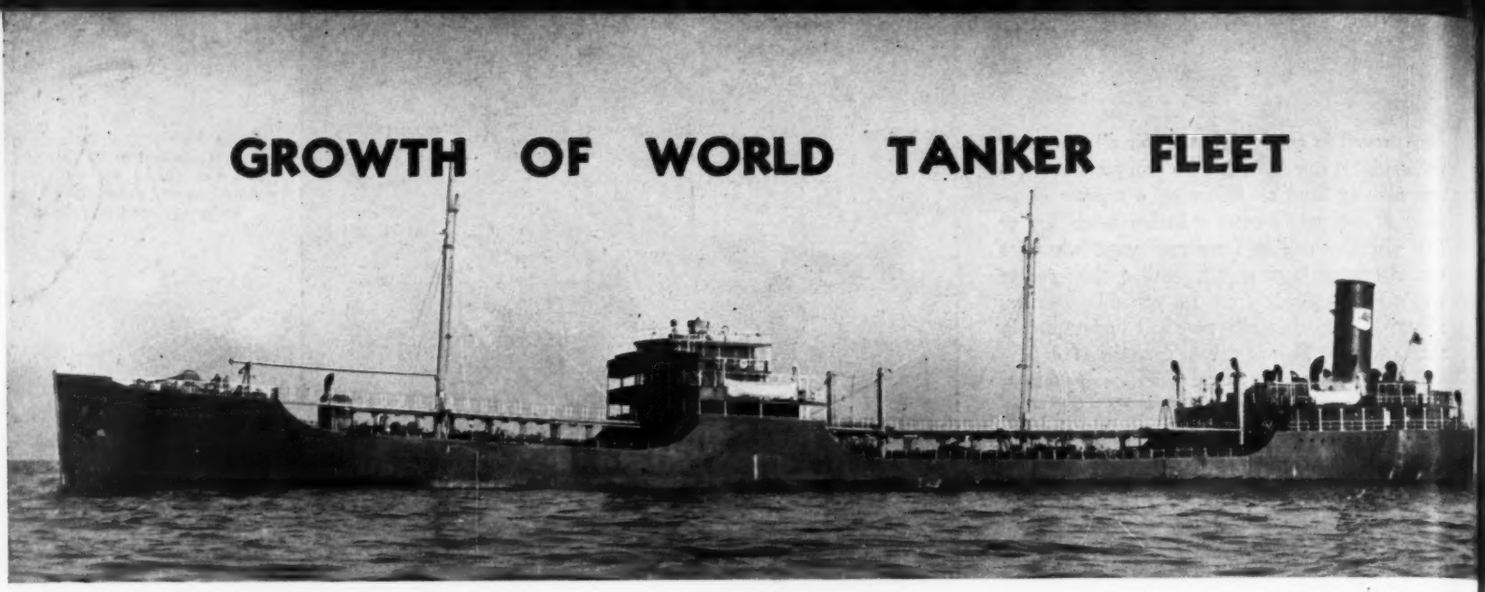
Scope on the Esso Parkersburg one of the first of 90 Standard Oil Co. (N.J.) tankers under American and Panamanian flags to be equipped with radar.



Closeup of radar antenna and horn on Standard of California's tanker R. G. Follis. →

Interior view of transmission unit on Atlantic Refining Company's Atlantic Mariner, the first commercial tanker to be equipped with radar. On its first radar-equipped run, in July 1946 the Atlantic Mariner averaged 16.3 knots per hour on the 2,280 mile trip from Corpus Christi, Texas, to Philadelphia, the fastest time which had been made on that run. ↓

GROWTH OF WORLD TANKER FLEET

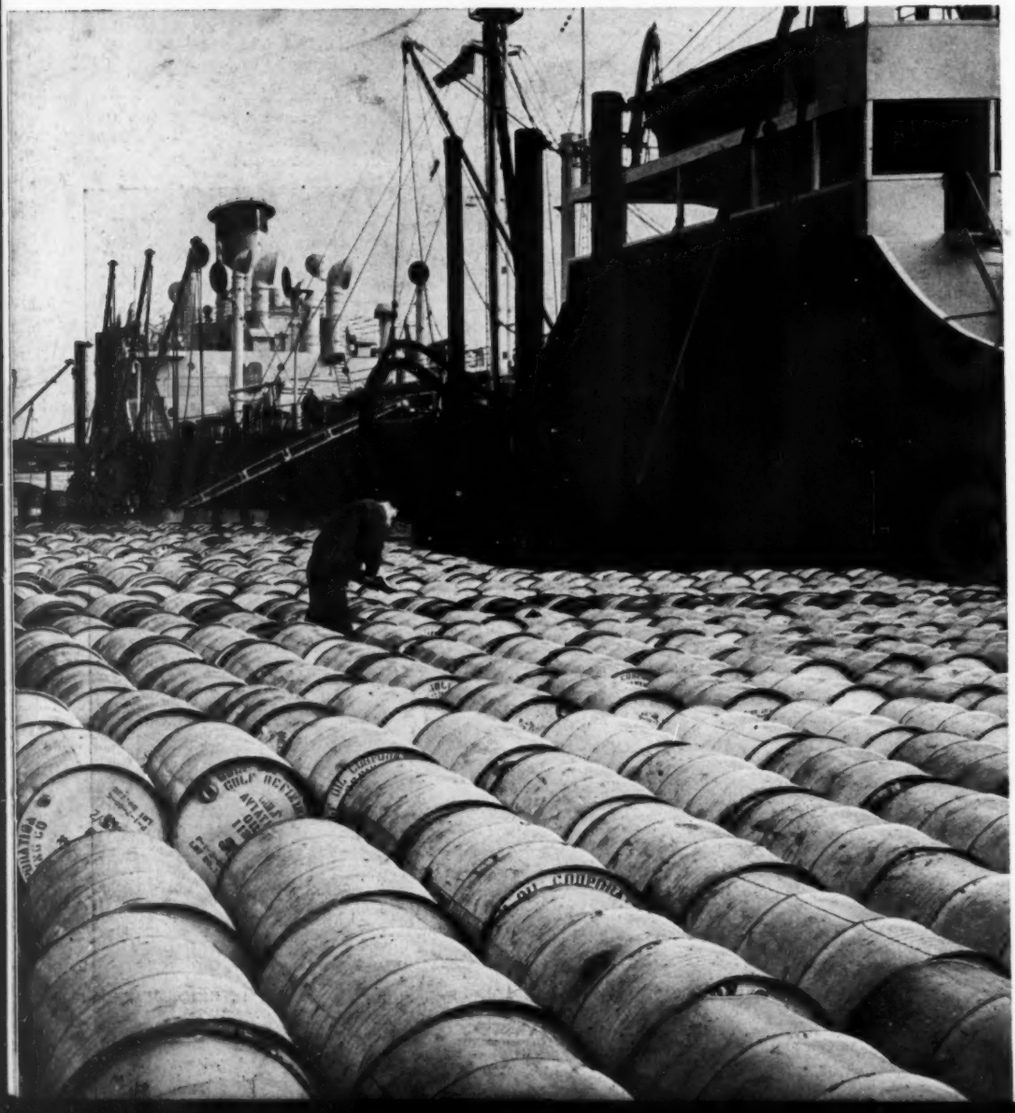


Socony Vacuum Oil Company's Mobilube is back in service after being torpedoed in the South Pacific in 1943, serving as a floating storage tank for the U.S. Navy and finally, at the close of the war, being towed from the Philippines to San Francisco for repair.

AT the commencement of World II in 1939, the world's ocean-going tanker fleet comprised roundly 1,590 vessels with a deadweight tonnage of 17 million tons. During the course of the war the losses incurred by Allied and neutral countries through various causes, largely of course through the depredations of German submarines, amounted to something over five and a half million tons. Because of the vital importance to the Allied cause of maintaining a constant flow of liquid fuels to its armies, navies and air forces around the globe, a huge program of tankship construction was put under way early in the war. The United States, with shipyards relatively secure from enemy attack and with better facilities for assembling materials and men for ship construction, took the lead in carrying out the program. In approximately three years some ten million tons of tanker vessels were launched from American shipways.

This remarkable record was made possible by concentrating on a single model, permitting the application of mass production methods to the majority of the vessels constructed. Thus it came about that 70 percent of the tankers built in the United States were of the class officially designated as T-2-SAE-1 and commonly referred to as T-2's. Of this design 481 ships were built for the United States Maritime Commission in the period 1942-45. They were 503 feet long, with a 68-foot beam and a depth of 38 feet three inches. They were single-screw ships equipped with turbo-electric drive generating 7,500 HP. Their specifications called for a speed of 15½ knots, and they had a cargo capacity of 140,000 barrels.

A Gulf Oil Corp. tanker being loaded with barrels of lubricating oil as well as bulk cargo.



The T-2's were greatly superior to the average prewar tanker which had only two-thirds their speed and probably less than 60 percent of their cargo capacity. While they formed the backbone of the Allied petroleum supply, a million and three-quarters tons of tankships had been built in Europe. Despite the heavy losses incurred during the war, therefore, the total tanker tonnage had risen by the end of 1945 to nearly 24 million tons, an increase of over 40 percent. While the tonnage and carrying capacity of the world fleet had risen so largely, however, the distribution of its components had undergone a great change. By reason of its building activity during the three preceding years the United States held 56 percent of the total tonnage, the greater part owned by the government. Britain had lost a million tons above its wartime construction, and Norway had seen the greater part of its fleet, a million and a quarter tons, disappear. During the next two years building activity was resumed in the United Kingdom, Scandanavia and the Netherlands, while most of the American fleet, aside from the vessels assigned to the Navy or sent to the scrap heap, had been sold either to American companies or to foreign operators. At the end of 1947 the total number of tankers according to best available records was 1,986 and their deadweight tonnage 23,600,000. The accompanying table gives the flags under which these vessels are registered together with the number and tonnage held by each nation.

As this table shows, the share of the United States has decreased to 45 percent, while Britain and Norway have made good strides toward regaining their former position, the former holding 21.6 percent and the latter 10 percent. These three nations control together some 76 percent of all tanker tonnage as against 72 percent in 1939. But whereas in that year the United Kingdom held the leading position with the United States second and Norway third, the United States now is first with the United Kingdom second and Norway third. Because the high cost of operation under the American flag makes it impossible for such vessels to compete in transoceanic service, a number of tankers owned by American companies are registered under other flags. This applies to the Panamanian fleet which comprises eight percent of the total.

While the speed and load capacity of ocean-going tankers have risen substantially since the end of the prewar period, transportation requirements have grown even more rapidly. The postwar rise in consumption in the United States together with the lack of sufficient pipeline capacity to meet the needs of the eastern states has made it necessary to assign more tankers to the movement of crude and products from Gulf Coast ports to the Atlantic Seaboard. The growth of this traffic from 1939 to 1947 is calculated as roundly 100 million barrels. Imports to the United States have increased an equal amount during the same period. Most of the imports have come from the Caribbean area, but a few cargoes have made the long journey from the Middle East. Exports have decreased slightly but not enough to make a substantial change in the picture.

In other parts of the world similar changes have taken place. The increase of demand in western Europe, particularly for distillate products, has been as great proportionately though less in volume, as in the United States. A larger share of these requirements has been drawn from the Middle East, some of it coming from the eastern shore of the Mediterranean, but a large part following the much longer route via Suez. Markets of Australasia and the Orient, formerly supplied by Far Eastern production which is still far below its prewar dimensions, have had to depend upon Persian Gulf fields, entailing much longer voyages. Altogether the dislocation of established trade movements combined with an extraordinary worldwide increase in demand has added greatly to tanked requirements, increasing them by one-third and possibly more nearly one-half as compared with prewar.

Other causes contributed to the shortage of tanker facilities which prevailed during the past year. Transfer of government-owned tankers in the United States to new owners was a slow-moving process. Changes in these vessels to fit them for peacetime use required much time. Construction of new ships in European yards was delayed by lack of materials and labor. Because of government-imposed restrictions on tanker rates or because of inability to complete needed repairs, a considerable number of British tankships, particularly the older and smaller vessels, were laid up. Failure to anticipate the sharp upturn in shipping requirements combined with these factors to prevent full utilization of existing tonnage.

It is pointed out that the completion of projected pipelines in the Middle East and elsewhere will shorten appreciably the length of some tanker voyages within the next few years. On the other hand it is practically certain that the growth in world demand for petroleum products will continue without diminution and will entail long ocean voyages and that these growing requirements will far more than offset any reduction resulting from pipeline construction. This trend is recognized by the petroleum industry in the inauguration of a new and extensive program of tanker building which will add probably three-quarters of a million tons of new capacity in the next year and a half through work now in progress in American, British and European shipyards. A continuation of this building activity well beyond the period covered by existing contracts must be anticipated in order to cover increasing requirements and replacements made necessary by obsolescence of vessels in service now.

A trend brought clearly into view by specifications laid down for the new vessels now building is the movement toward greater speed and larger cargo capacity. This tendency is made necessary to counteract in some measure the increase in operating costs, but it has its limitations. The number of ports which can be entered by these oversize vessels is limited, and large-scale expenditures on harbor improvement and extension of loading and discharge facilities must precede their general adoption.

World Tanker Fleet

Jan. 1, 1948

Nation		Number	DW Tonnage
United States		772	10,587,771
British Empire		482	5,139,131
United Kingdom	445		
Canada	24		
Other Dom. & Col.	13		
Argentina		29	231,740
Belgium		5	59,931
Brazil		7	57,316
China		4	46,000
Denmark		11	149,561
France		44	502,620
Greece		5	39,501
Italy		43	435,716
Japan		12	74,122
Mexico		12	117,122
Netherlands		84	571,432
Norway		188	2,407,491
Panama		157	1,976,522
Portugal		6	45,728
Spain		21	178,705
Sweden		36	506,756
Soviet Union		24	219,432
Venezuela		24	98,072
Others*		20	159,506
TOTALS		1,986	23,603,175

*Others include Chile 3, Colombia 1, Egypt 1, Finland 4, Honduras 2, Peru 1, Poland 1, Switzerland 2, Siam 1, Turkey 1, Uruguay 2, Yugoslavia 1.

Discharging bulk cargo. Photo by Eagle for Standard Oil Co. (N.J.)

FINANCING TOMORROW'S OIL*

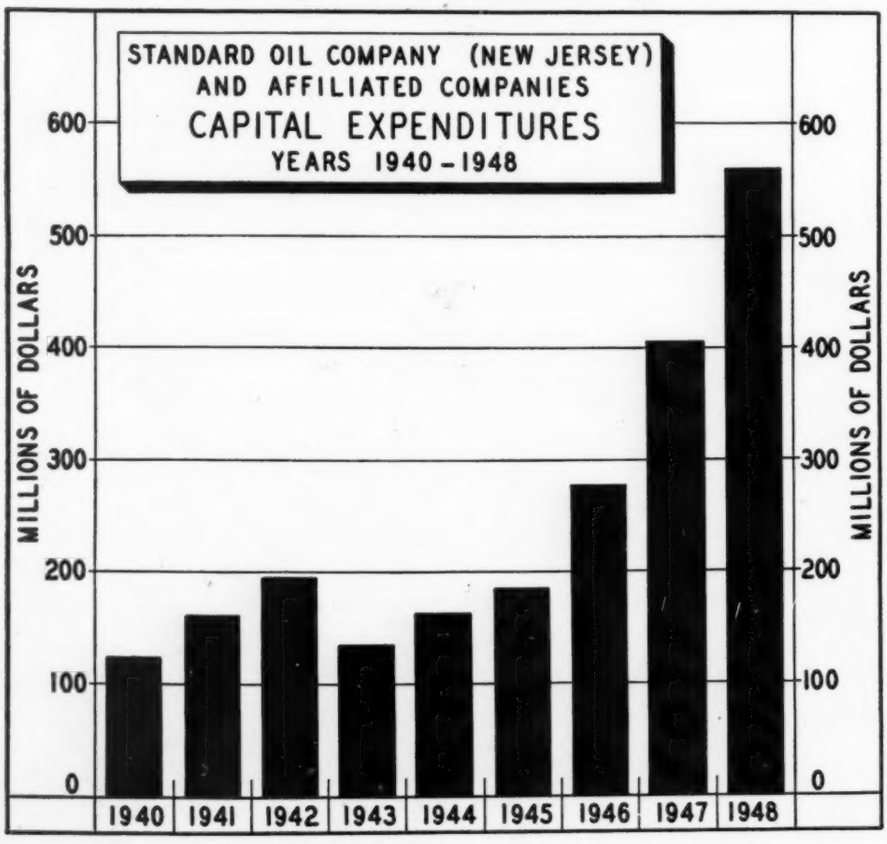
Capital Expansion of United States Oil Companies in 1947 Totaled Nearly One Billion Dollars, of which Nineteen Percent Came from Common Stock; Four Percent from Preferred Stock; Fifty Percent from Banks and Twenty-Four Percent from Insurance Companies

DURING 1947 the oil industry spent more than $2 billion to meet the future oil requirement of the United States. Nearly half of this huge sum was obtained by new financing operations. New records were set in the amount of money spent for exploration and drilling for new oil, and construction and modernization of facilities. This was a staggering expenditure even in an industry which always has been on the move in an effort to meet the ever-growing demand for the usual run of oil products and new products for industry and the public.

The postwar period has pointed up the basic characteristic of the oil industry which make capital expenditures the major use for its cash earnings. The outstanding feature of the oil industry always has been its steady growth. Last year the demand for petroleum and products averaged about 5,844,000 barrels daily which was nearly 10 percent above the 1946 level and 34 percent above the prewar peak in 1941. In addition to growing demand, the highly technical nature of the development of oil reserves and refining processes requires large annual expenditures because new and more efficient equipment is constantly being developed. In order to maintain their competitive position in the industry, oil companies are required to modernize their plants regularly as equipment becomes obsolete. The large research programs of all major companies make the rate of obsolescence rapid.

The changing nature of the markets for oil products has brought major revisions in oil refining equipment in the past, and this trend undoubtedly will continue in the future. The development of the automobile, the wide adoption of oil burners for residential heating and the coming of age of the airplane have resulted in the rapid multiplication of mechanisms utilizing liquid fuels. Others, now on the horizon, will require fuels not produced in quantity today. As the automobile industry turns to higher compression engines, the oil industry will be called upon to supply the fuel for these engines. Jet propulsion creates demands for a different type. These are just examples of the developments which the oil industry must meet in the future.

This chart of Jersey Company capital expenditures (1948 estimated) is typical of the industry and indicates why it has been necessary for most companies to resort to large-scale financing.



A number of factors have accelerated capital programs in the oil industry since the war. The unexpectedly sharp increase in consumption immediately after the war has required a speeding up of expansion programs in exploration, drilling, pipeline and refining operations. After concentrating for several years on meeting military requirements, financial requirements for the postwar expansion and modernization program would have been of record proportions without the general rise in the price level. The substantially higher costs of replacement have sky-rocketed the dollar cost of the present capital program of the industry. The costs of finding oil today, building new refineries, transportation and marketing facilities are two, three or four times pre-war levels.

In addition to its capital expenditures, the oil industry is faced with the usual financial requirements of all industries necessitated by greater volume and higher prices. Working capital requirements, particularly for those companies engaged in refining and marketing operations, have risen as demand has increased and crude oil and product prices have risen. Net working capital requirements will continue to rise as inventories grow to the point where they bear a more normal relationship to demand.

The oil companies in the best position to meet the financial requirements of the current expansion program are those companies which are fully integrated or are engaged primarily in the production and sale of crude. It has been possible for many of these companies to generate enough new capital from earnings to meet their exploration and development programs for the expansion of crude oil reserves. The rise in the price of crude since mid-1946 has added substantially to earnings of producing companies. The higher net income, plus the depletion allowances permitted, enabled them as a group to increase

* This article was especially prepared for WORLD PETROLEUM by the Petroleum Economics Division of Merril Lynch, Pierce, Fenner & Beane.

their exploration and drilling activities and still add to their cash balances in 1947.

Whether financing will be necessary for producing companies in the future will depend primarily upon the course of crude oil prices. Based on present prices, these companies should be able to meet the costs for their near term drilling and exploration programs. However, the costs of finding and developing new oil have risen sharply and are expected to continue upward. Consequently, any decline in crude oil prices from present levels would necessitate some financing by producing companies if they are to maintain their competitive position in the industry through finding and developing more domestic oil. Some U. S. producing companies are extending their operations to foreign countries where per barrel costs of production are generally low, but development abroad requires a heavy capital investment.

Financial requirements have been heaviest for those companies engaged principally in refining and marketing. While earnings have increased, the rise has not been as sharp as that for crude. Capital programs of these companies are so extensive and replacement costs so far above prewar levels that most companies were either forced to draw upon net working capital during 1947 or obtain new funds from outside. Because earnings are expected to rise in 1948 and dividend payments to continue modest in relation to earnings, financing by these companies may be at a somewhat lower level during 1948.

The financing of new facilities in the past has been accomplished on a fairly conservative basis. Although debt was incurred during years of rapid expansion, producing and integrated companies were able to cut back debt in periods of slower growth. Also when expansion was less rapid, the industry as a whole was able to pay larger dividends relative to net income. Most conservative capitalization is found in the producing group. Despite a substantial writedown of assets during the thirties, long term debt was below 12 percent of total capitalization at the end of 1946. This ratio was probably lowered during 1947. Integrated companies have maintained the steadiest capital structure. Although debt has increased it represented a smaller portion of total capitalization in 1946 than in 1929 and 1941. Largest increase in debt has occurred among the refiners who purhase the major share of their crude oil. Apparently capital expenditures are larger relative to net income in this group as is indicated by the lower rate of return on invested capital.

There is an important factor governing the trend of capitalization over which the industry has no control. This is the condition of the money markets at times when the industry has been in need of new capital This proved to be a major factor in 1947. In a year of rising interest rates and a general public disinterest in preferred and common stocks, the industry was forced to raise the bulk of its new capital through borrowings. It has been estimated that the industry acquired close to a billion dollars of new capital during the year of which more than three-quarters came from borrowings while 19 percent was derived from the sale of new common stock and four percent from the sale of preferred stock. Not only was a large percentage of the new capital borrowed, but it was not debt which was sold to the investment public. Fifty percent of the new capital acquired in 1947 was borrowed from banks while another twenty-four percent received directly from insurance companies. The poor condition of the money market during 1947 had the effect of substantially increasing the senior capital of oil companies and also raising the percentage of total invested capital prior to the common stock.

If sufficient steel is made available to the oil industry in 1948, capital expenditures probably will approximate the 1947 level. The tightening of bank credit indicates that this will not be a ready source of new capital for the oil industry in 1948. At the moment, there do not seem to be any signs of a revival of the investment market. Consequently, the industry will have to look more to earnings as a source of capital funds than it did in 1947. It appears, therefore, that while dividends will probably be maintained at current levels, they will represent an even smaller percentage of net income in 1948 than they did in 1947. With the heavy capital program continuing through 1948, it is unlikely that any major reduction will be made in borrowed capital while it is probable that there will be some increase in borrowings for the industry as a whole. The reinvestment of a higher portion of earnings in 1948 probably will reduce the importance of fixed debt to total capitalization for the industry.

As in the past, the longer term trend of financing in the oil industry will be dependent upon earnings and the condition of the money market. Future earnings will gradually become a more realistic statement of profits. As depreciation and depletion charges on oil reserves and facilities now being created account for a greater percentage of expenses, these charges will be more closely in line with replacement costs. Since the end of the war, depreciation and depletion charges have borne little relationship to replacement costs and have been largely responsible for the low dividend payments relative to net income and the need for new capital.

If future prices for crude oil and refined products are sufficient to maintain current operating margins, the industry probably will be able to complete its expansion programs with sufficient cash remaining to retire the debt which has been accumulated since the war. However, if oil prices should decline, such as might occur during a severe recession, and operating margins contract, additional financing might be expected to meet future expansion and modernization programs. Furthermore, under these circumstances, it probably would be necessary to place much of the bank borrowings of 1947 on a more permanent basis. Companies might be forced to fund these borrowings on a longer term basis at higher interest rates or attempt additional equity financing. The exact nature of this refinancing would depend primarily upon the condition of the money markets.

Capitalization of Seven Refining Companies

(In Millions)

	1929	% Total	1937	% Total	1941	% Total	1946	% Total
Long Term Debt	$ 219.9	10.2	$ 239.5	10.6	$ 296.7	12.8	$ 361.6	12.2
Preferred Stock	42.4	2.0	82.2	3.7	76.8	3.3	77.2	2.6
Common Stock & Surplus	1,897.3	87.8	1.927.9	85.7	1,952.0	83.9	2,526.7	85.2
Total	$2,159.6	100.0	$2,249.6	100.0	$2,325.5	100.0	$2,965.5	100.0
Net Income	174.0		168.0		151.6		203.3	
% Return on Capitalization	8.1%		7.5%		6.5%		6.9%	
% Net Income Paid Out in Dividends	39.8%		54.0%		42.4%		41.2%	

Capitalization of Ten Producing Companies

(In Millions)

	1929	% Total	1937	% Total	1941	% Total	1946	% Total
Long Term Debt	$ 44.6	9.2	$ 14.4	4.0	$ 43.0	11.6	$ 64.7	11.9
Preferred Stock	8.9	1.8	65.7	18.1	31.7	8.5	27.0	5.0
Common Stock & Surplus	432.9	89.0	281.8*	77.9	297.1	79.9	451.1	83.1
Total	$ 486.4	100.0	$ 361.9	100.0	$ 371.8	100.0	$ 542.8	100.0
Net Income	40.4		39.7		40.4		75.7	
% Return on Capitalization	8.3%		11.0%		10.9%		13.9%	
% Net Income Paid Out in Dividends	45.0%		63.5%		40.8%		36.5%	

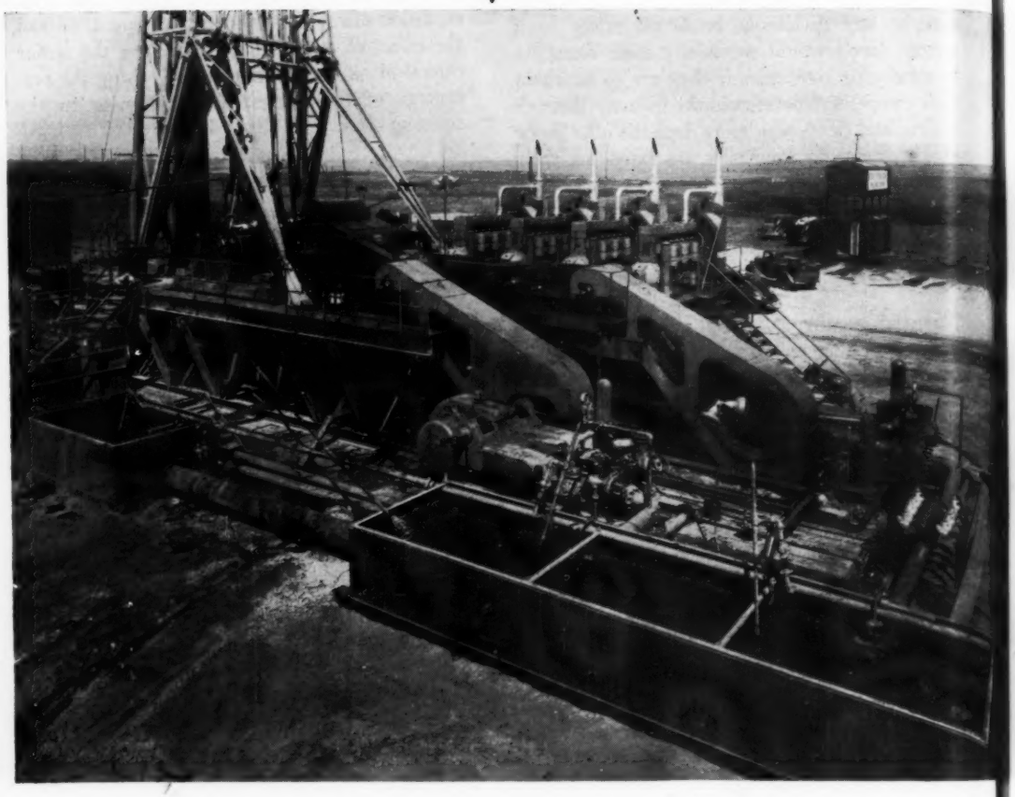
*—Decline reflects write down of assets in early 1930's.

Capitalization of Eleven Integrated Companies

(In Millions)

	1929	% Total	1937	% Total	1941	% Total	1946	% Total
Long Term Debt	$ 640.7	15.5	$ 497.1	11.7	$ 731.4	16.0	$ 793.6	14.1
Preferred Stock	69.0	1.7	116.1	2.7	72.5	1.6	68.7	1.2
Common Stock & Surplus	3,413.3	82.8	3,649.1	85.6	3,766.5	82.4	4,785.9	84.7
Total	$4,123.0	100.0	$4,262.3	100.0	$4,570.4	100.0	$5,648.2	100.0
Net Income	525.4		398.4		357.6		$42.3	
% Return on Capitalization	12.7%		9.3%		7.8%		9.6%	
% Net Income Pair Out in Dividends	31.8%		46.4%		50.9%		45.3%	

DIESELS FOR ROTARY RIGS IN DEEP DRILLING*



Drawworks, and diesel powered rig drive of a large portable rotary rig.

This article describes diesel drilling engines and their application to large rotary rigs for drilling the increasing number of deep wells required by the global search for petroleum to supply the expanding needs of the peoples of the world.

PERHAPS the reader will be interested in an attempt to explain briefly why there is a world-wide search for petroleum. In the United States the current annual consumption is estimated to be very nearly 600 gallons per capita. With not over six or seven percent of the world population and land area, the United States at present produces and consumes nearly two-thirds of the world output of petroleum. Consumption has increased approximately 35 percent since last prewar year 1941, and it has been predicted that it will continue to increase for years to come, perhaps being one-third greater in 1956.

The foregoing explains why there is great drilling activity in continental United States where more than 2,000 rotary drilling rigs were estimated to be active as of January 1. An even larger number would be in service but for the acute shortage of steel, of which a large tonnage is required for well casing and flow tubing as well as for drill pipe. In spite of handicaps a total of more than 33,000 wells were drilled in 1947, and possibly as many as 36,000 wells may be drilled in 1948 if the steel is made available.

Exploratory drilling is proceeding on a large scale, and the new Benedum field in West Texas with its 12,000-foot discovery well is one of the more spectacular recent results. In the exploration of the Continental Shelf in the Gulf of Mexico a recent 13,000-foot well is 18 miles offshore, and a well now drilling is 25 miles out. Wildcat drilling in almost every part of the Union shows the persistent effort made to find new oil-producing areas.

Outside of the United States practically the whole increase in petroleum supply since 1940 comes from Venezuela and the Middle East; petroleum production in the rest of the world, taken as a whole, (but excluding the United States, Venezuela and the Middle East) being less than prewar. The annual consumption per capita as an average for the whole Eastern Hemisphere (excluding Russia,) has been estimated roughly as being only about three percent of the current per capita consumption in the United States. Regardless of any allowance which may be thought desirable for possible error in such estimate, the sharp contrast between per capita consumption in the United States and per capita consumption in the Eastern Hemisphere is startling. The demand greatly exceeds the available supply, and there is an acute oil shortage in the Eastern Hemisphere.

Time will be required to restore and greatly expand the urgently-needed oil producing, refining and transportation capacity depleted by the late war and its aftermath in various areas of Europe and Asia; also to discover and develop new petroleum reserves. But on the assumption that reconstruction and stabilization of Europe and Asia will occur, Joseph E. Pogue has predicted that oil production and consumption outside of the United States will increase perhaps 76 percent during the decade ending in 1956. This 76-percent-increase for the rest of the world is to be compared with the 37-percent-increase tentatively predicted for the United States for the same period.

As a result of the interest awakened by this world-wide demand, exploration is going on in practically every area where geological conditions are favorable. Merely a summary review of active oil exploration and drilling arranged alphabetically by country would occupy more space than this article. American-built rotary drilling rigs are now operating or are planned to be operating in many of the places where oil is being sought, such as the Bahamas, Cuba, nearly every country of Central and South America, southern France, Morocco, Egypt, Ethiopia, Arabia, Burma, East Indies, Philippines, Australia and others. American machinery, drillers and technique are going overseas to increase the world supply of petroleum. In Canada the important discovery of the new Leduc field near Edmonton has stimulated greater drilling activity in the prairie provinces. Exploration in Ontario and in the maritime provinces is continuing. In Alaska wells are being drilled in the U. S. Naval Reserve south of Point Barrow, and the possibility of other exploratory drilling is mentioned. Mexico is reported to be planning renewed drilling and exploration, which was interrupted by the revolution and the expropriation of the oil properties. Russia has very large oil reserves, and future discoveries in the vast expanse of territory in the U.S.S.R., in Europe and Asia reasonably may be expected to increase enormously the world's reserves of petroleum. For the present we can only infer that behind the "Iron Curtain" the rate of development is relatively slow; partly because of limited equipment and shortages of essential material, for some of which the United States and western Europe were prewar sources.

* Prepared by Superior Engine Division, National Supply Co.

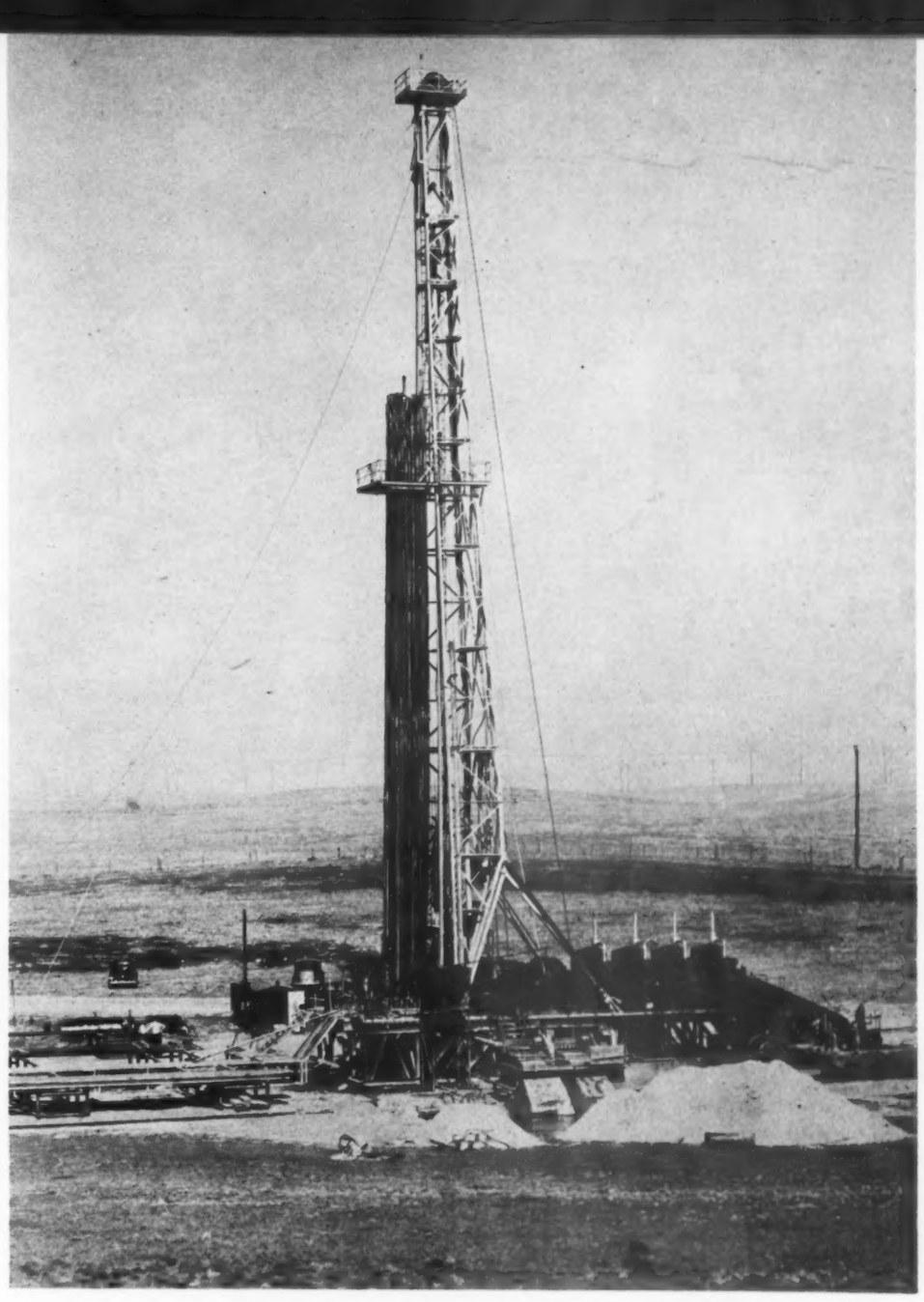
The sedimentary stratified rocks which are possible reservoirs of petroleum have in some areas a thickness of many thousand feet. Not only the shallower strata must be explored but the deeper sedimentary rocks which may possibly contain oil must be drilled. Wells of 10,000 and 12,000 feet no longer excite special remark. Wells have been drilled below 17,000 feet. The greatest depth yet reported is 17,823 feet. There is discussion of wells 20,000 feet deep. Deeper drilling than in the past and also many more deep wells have created an increasing demand for drilling rigs sufficiently powerful and suitably equipped to drill deep wells. Since an estimated 80 percent of new oil wells in the United States are drilled on contract, there is every incentive for the drilling contractor to employ the most efficient drilling equipment obtainable.

The modern rotary drilling rig is the result of the persistent effort of a large number of engineers, technicians in many fields, designers and operators during nearly a half century since the first approximation of present rotary drilling technique came into important use to drill oil wells. The diesel mechanical-drive rotary rig has come into general use because of its adaptability to practically all conditions, moderate unit weights to be moved, relative simplicity, reliability, in addition to low operating and maintenance costs.

The diesel engine consumes less fuel than any other prime mover. Water consumption of the diesel is very small. Except for starting air and storage for fuel oil, the diesel is a self-contained power unit, being complete in itself. Unit weights and total weight per rig are moderate; large power is available with relatively light weight. The diesel has a wide speed range, quick response to throttle control and fast acceleration. Diesels are drilling oil wells in every zone from the Tropics to the Arctic, under the most varied conditions.

Not only may climatic and other conditions be difficult, but drilling operations often must be carried on in comparatively inaccessible localities. Transportation may be so acute a problem that its low fuel consumption and the very small water requirements will make the diesel the only kind of power which can be considered.

It is generally accepted that a large fraction of the actual horsepower hours consumed in drilling a well are applied to the mud pump or pumps, which is a continuous load for as long as circulation of the mud fluid is maintained. Usually, however, the peak power requirement is intermittent, for hoisting the drill pipe to change the bit. This operation consists of a succession of short lifts in a cycle of perhaps one to two minutes, repeated on a deep well for some hours before the new bit reaches the bottom and drilling can be resumed. For a fraction of a minute all available power may be used to accelerate the lift. Then, while a section of drill pipe is being removed, the engine RPM drops to idling speed. Almost immediately thereafter the engines are again operated at top torque and fastest rate of acceleration during the seconds of the next hoisting period.



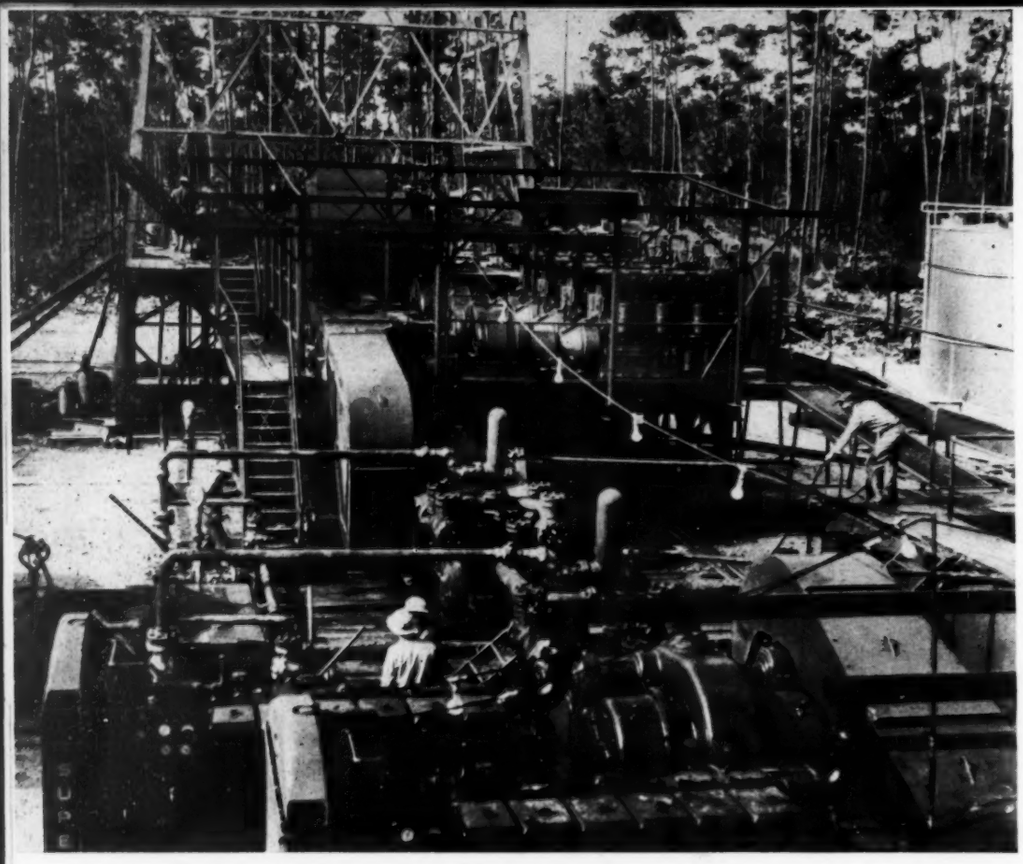
Diesel powered rotary rig with 136-foot cantilever mast with drill pipe stacked.

It may be of interest to refer to published discussion of possible future hoisting conditions for drilling very deep wells up to 20,000 feet. It is stated that the static weight of the string of drill pipe may approach 400,000 pounds and that the derrick should be high enough to handle the drill pipe in 135-foot sections. It is also estimated that static weight of casing string may exceed 800,000 pounds.

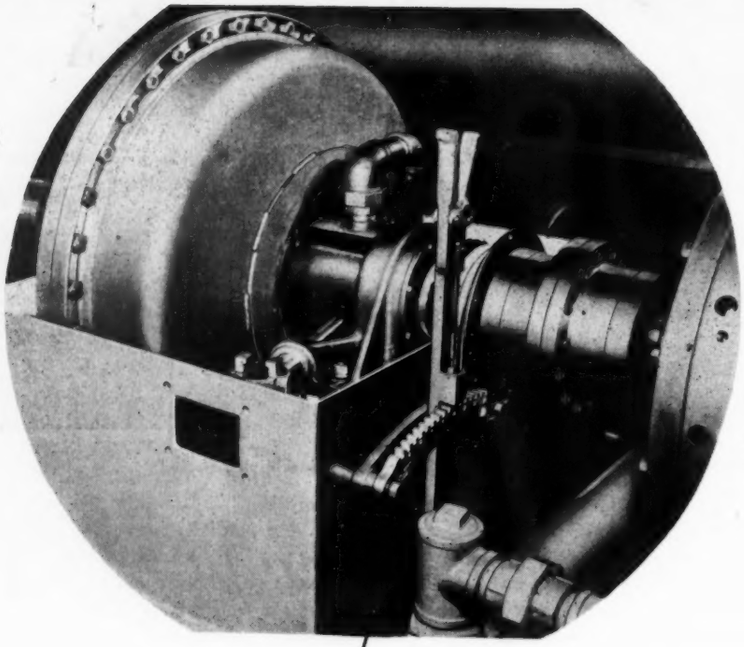
The maximum horsepower which can safely be applied to rotate the drill pipe is so moderate than when the rig power plant is inadequate for other operations, it will usually be found unnecessary to give special consideration to engine capacity to drive the rotary table.

Usually on the larger mechanical-drive rigs there are three or four diesels behind the drawworks depending on: (a) the horsepower capacity of engine selected; (b) the capacity of the rig; (c) the depth of the well to be drilled.

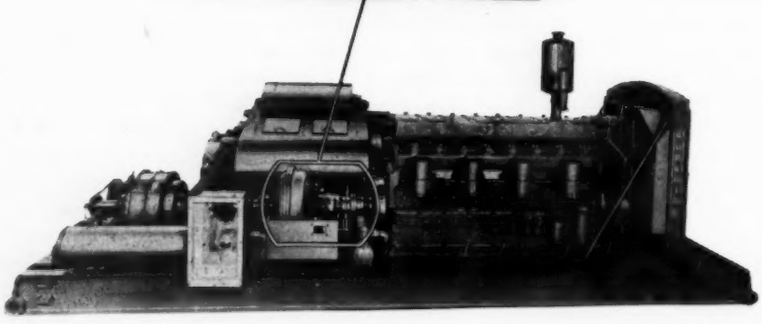
The engines are coupled to a chain transmission which transmits their combined power, i.e., the engines are compounded. (Compounded is the term commonly used in the United States, but technically the engines are "paralleled.") There are means for de-clutching any engine from the others. Ones or two of the engines may drive the pump or pumps, while another engine can be operated separately to rotate the drill pipe. Usually the combined power of all the engines is utilized for the hoisting operation. Engine speed is at all times controlled from the derrick floor by the driller. On some present-day rigs the clutches on the various rig drives can be controlled by the driller, also any engine can be clutched or de-clutched from the driller's position. The use of air-actuated clutches and hydraulic couplings facilitates derrick control.



Six diesels are used to power this exploratory drilling rig operating on deep tests in a Latin American country.



Gyrol fluid drive on one section of a 3-engine sectional drive.



Helixhaust manifold for 8-cylinder supercharged diesel.

The first use of hydraulic couplings on a rotary drilling rig rates back perhaps a dozen years. Based on experience through the years, the latest design of diesel mechanical-drive rig employs a compact hydraulic coupling which is located adjacent to the engine power take-off. The simplified coupling assembly is without contact or wear on moving parts other than roller bearings and seals. A sliding scoop control mechanism speeds of filling or emptying of the coupling, which when empty of oil cannot transmit torque or power. The sliding scoop control mechanism is operated manually; or optionally, can be arranged to be actuated by air control from driller's position. The hydraulic coupling serves as a cut-off clutch between engine and rig transmission shaft. Any other clutch on engine is dispensed with.

Hydraulic couplings provide a cushion between the engines and driven machinery to reduce shock loading of rig clutches, pumps, hoisting equipment and string of drill pipe, and will not transmit harmful torsional vibrations.

The Gyrol fluid drive makes use of the most efficient type of hydraulic transmission. With situable adjustment of fluid filling and of engine speed for minimum slip, the efficiency is as high as 96 to 98 percent. The efficiency of course falls off in proportion as the slip of the coupling increases. In addition to one or two pumps powered by the rig drive, the larger rigs optionally may have additional pump or pumps, each such pump powered by an additional separate engine. The independent pump or pumps may be used for maintaining an extraordinary rate of circulation, if needed. An independent pump provides a standby unit. It may sometimes be employed as an auxiliary for mud mixing. The fluid drive makes unnecessary any other type of clutch between engine and pump.

The four-cycle, 8½ x 10½ inch, six and eight-cylinder Superior diesel engines shown in accompanying illustrations are the result of development through years of experience with the exacting and varied requirements of rotary drilling. These engines are operating on drilling rigs in every important oil-producing area in the world. Usable power for hoisting is conservatively rated at 345-BHP, 460-BHP and 700-BHP for the respective models. With radiator cooling the power taken by fan driven from engine must be deducted from these ratings as ascertain the available horsepower.

Available Horsepower (with Radiator Cooling) at 900 RPM

	Naturally Aspirated	Naturally Aspirated	Supercharged
Number of cylinders	6	8	8
BHP for hoisting	325	435	670
BHP for slush pump	280	375	620

These diesel drilling engines are ruggedly constructed. They are completely enclosed, oil-tight and dust-proof against sand storms. The design permits ready inspection and quick access to all parts likely to require attention for any reason other than a major overhaul. The wet-type

cylinder liners are replaceable. The tri-metal precision-type main and crank pin bearing shells can be removed and replaced without any fitting.

The camshaft can be removed within the longitudinal space occupied by the engine. The individual fuel injection pump for each cylinder is accessible by removing a light cover at operating side of engine. The fuel injector and valve rockers are accessible by removing a light cover at top. The built-in water pump, fan and their drives are of substantial durable construction with ball and roller bearings. They are all outside of crankcase and easily accessible. The operators are protected by guards around V-belt drives to water pump and fan. The built-in lubricating oil pump for the full-pressure oiling system, the edge-type and bypass-type filters and the water-cooled lubricating oil cooler are easily accessible. A rotary-type service fuel pump delivers fuel oil under pressure to the filter and to the suction manifold of the fuel injection pumps. Oil bath type intake-air filters wash the incoming air. Exhaust pyrometer, tachometer and pressure gauges for fuel oil and lubricating oil assist in operation. An alarm bell rings for failure of lubricating oil pressure or excessive temperature of cooling water.

The diesel is started by compressed air at 150 to 250 pounds, which provides a very high turning effort and great reliability as a means to rotate the engine initially for starting. Firing usually commences in the cylinder which first completes a compression stroke. Compressed air usually is furnished by a small auxiliary air compressor driven by a small engine or by electric motor. The air compressor operates intermittently to maintain pressure in the tank or tanks.

There are two governed speeds, viz., full load governed speed at 900-RPM and idling governed speed at 400-RPM, all intermediate speeds being under derrick control by the driller. Usually air control is employed. Thus the engine can be accelerated or decelerated between 400 and 900 RPM or can be operated at full governed speed, at idling speed or on the throttle at any intermediate speed as may be desired by the driller. Stop collars on the fuel pump metering racks restrict the intermittent overload which can be imposed on the engine. After the stops engage, any additional load will cause the engine to slow down in speed, thus giving warning.

The cooling system is of radiator type, sealed to prevent escape of water vapor until the pressure rises above atmosphere and temperature rises above boiling point, being of ample cooling capacity for atmospheric temperatures encountered in any oil-producing area where these engines have been used. Water consumption is small. The radiator has ten core sections, any section being replaceable without disturbing the others.

A rugged type of thermostat-actuated three-way valve by-passes the jacket cooling water around the radiator until the engine has warmed up. Since a given drilling rig and engines have been known to be moved from the tropics to sub-arctic or from temperature zone to Arabia, the ample cooling capacity and temperature control are important because of the wide range of climatic conditions to be met.

For the larger rigs required for deep drilling, the supercharged diesel is now available. The Buchi system of turbo-charging gives 60 percent greater power than the naturally-aspirated engine with only about 15 percent increase in weight and no increase in space. Weight per horsepower is thus reduced by about 30 percent by supercharging.

This supercharged diesel is rated 650-BHP for driving the mud pump and is conservatively rated 700-BHP for hoisting. With radiator cooling 30-HP must be deducted for power taken by fan when driven by the main engine.

Three supercharged engines can be compounded behind the drawworks to give 2000-HP for hoisting. Two of the three engines will then be available to drive pump (or pumps) during the drilling operation. Some rigs have two pumps powered by the rig drive.

Supercharging of the diesel drilling engines herein described requires: (1) a turbo-charger; (2) an exhaust manifold with multiple passages; (3) valve timing to provide for scavenging as hereafter explained; (4) oil cooling of pistons; (5) lubricating oil pump and oil cooler capacity adequate for both bearing lubrication and piston cooling.

The Buchi turbo-charger is a waste-heat gas turbine with the rotor of a centrifugal blower mounted on the turbine shaft and supported by the same bearings that carry the turbine. This type of turbo-charger has been built and used in Europe and America for years.

Part of the otherwise wasted energy of the hot exhaust gases is utilized by the turbine to generate power to drive the blower. The blower in turn supplies all of the air required for scavenging and for combustion at a pressure above atmosphere. A conventional type of intake manifold connects the blower discharge to the intake valves in heads of the respective cylinders.

Supercharging increases horsepower capacity of the engine in two ways:

(1) The so-called clearance volume, i.e., space between piston crown and cylinder head, is occupied by the hot inert products of combustion at the end of the upward or exhaust stroke of the piston. In the supercharged engine the exhaust valve is held open long enough after the intake valve opens for the hot inert gases to be blown out and replaced by cool undiluted fresh air; the operation is called "scavenging." This increased quantity of new air furnishes oxygen for the combustion of a greater weight of fuel with a corresponding increase in power.

(2) Not only the clearance volume but also the entire cylinder during the intake stroke, after closure of the exhaust valve, is filled with air from the turbo-blower at a pressure somewhat above atmospheric; this increase in pressure is what is meant by "supercharging." Since at a given temperature the weight of oxygen available for combustion is directly proportionate to the absolute pressure of the air charge in the cylinder, the weight of the fuel which can be burned and the power which can be generated are increased by supercharging.

The large gain in power of the supercharged engine results chiefly from a slightly longer period of maximum gas pressure to produce a higher average, the additional power thereby being obtained with but small increase in firing or maximum pressure. There is only a negligible increase in main bearing and connecting rod bearing maximum pressures and stresses in engine members. Little additional jacket water cooling system capacity is needed because considerable heat is carried away by the scavenging air, which blows through the cylinder and cools cylinder head, valves, piston and cylinder walls. No control equipment is necessary for the turbo-charger. The rotative speed of turbine and blower automatically rises and falls with increase or decrease in the weight and temperature of the exhaust gases from the engine. The speed of turbine and blower, therefore, varies up and down with the speed and load of engine; likewise the discharge pressure of the blower, i.e., the degree of supercharging, varies with the load on the engine and always exactly matches the load within the rated capacity of the engine.

Noteworthy is the quick response of the turbo-charger to load changes and to manipulation of engine throttle by the driller. The fast acceleration and ample power of the supercharged diesel give exceptional performance behind the drawworks when hoisting.

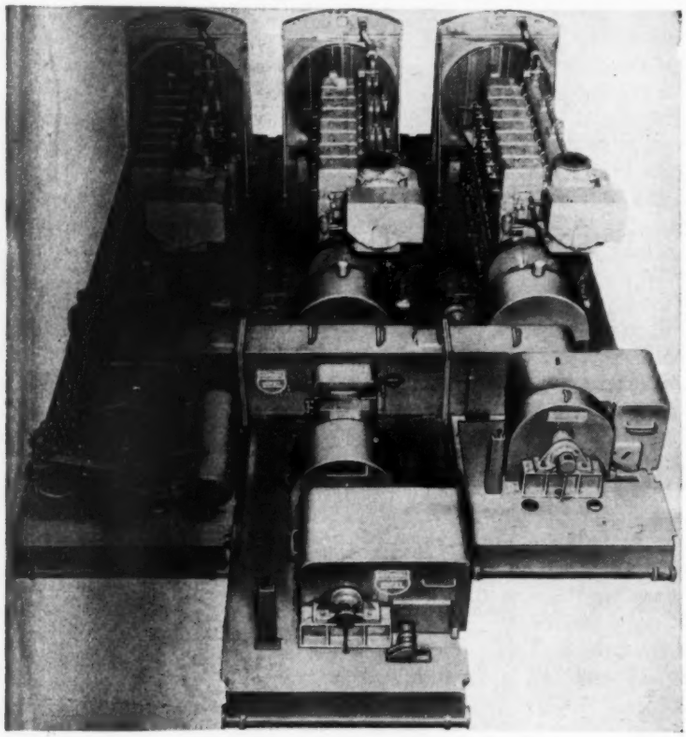
There is no mechanical connection between diesel engine and turbo-charger other than the supporting bracket, the manifolds for intake air and exhaust and the pipes for jacket cooling water. The oiling system for its bearings is completely self-contained with the turbo-charger.

Efficient operation of the gas turbine which drives the centrifugal blower requires for an eight-cylinder engine that the exhaust manifold have four passages. Each passage conducts the exhaust gases from two cylinders to the turbine nozzle box. Thus there can be no blow-back from the exhaust of any cylinder to any other cylinder. The lengthwise partitions between the four longitudinal passages in the cylindrical exhaust manifold are welded to the longitudinal pipe which is located at the central axis of the manifold. These lengthwise partitions are twisted into helical form, thereby permitting ready connection to the same passage of two cylinders having the working cycle separated by 360° crank angle, viz., Nos. 1 and 8, 2 and 7, 3 and 6, 4 and 5 respectively. At one end the twist of the helix is right-hand, changing at mid-length of manifold to left-hand. The cylinders of each pair which exhaust into the same passage not being all adjacent, the helix is used to detour the exhaust passage in the manifold around the intervening exhaust connections from other cylin-

ders. The exhaust manifold is water-cooled, which minimizes fire hazard. This unique design of manifold is known as the "Helixhaust." A combined air filter and silencer is mounted on the intake of the turbo-blower.

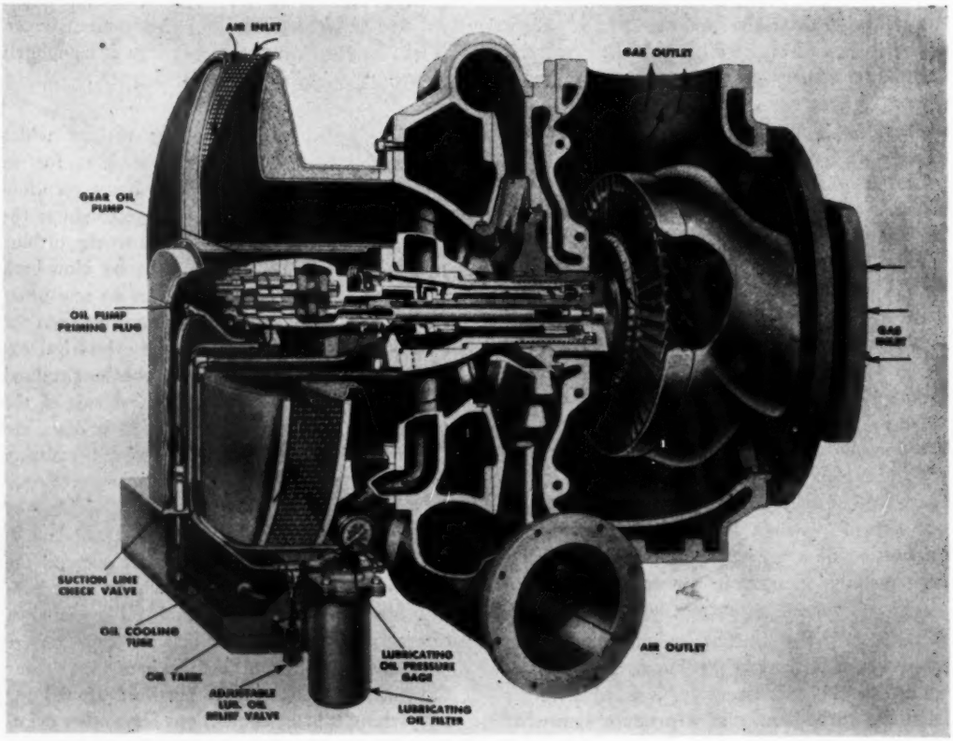
The pistons of the supercharged diesel are cooled by oil from the engine lubrication system, circulated under pressure through the chamber underneath piston crown. Adequate cooling for the oil before recirculation is provided by the shell-and-tube type heat exchanger through which water from the radiator passes before re-entering the jackets of the engine cylinders.

The low fuel consumption of the diesel is important to reduce drilling costs. Roughly the fuel oil consumed by a drilling diesel of the type herein described is about 1.5 U. S. gallons per 24-hour-day, per brake horsepower at full speed and full rated load. The economy falls off somewhat at extreme light loads and a certain amount of fuel is required even when the engine operates without load, i.e., fuel will be consumed.



← Three-engine sectional rig drive with hydraulic transmission. Arranged two slush pumps.

Sectional view of Buchi turbo-charger. ↓



Engines are usually applied to rig on the basis of the peak horsepower required for hoisting each section of drill pipe, which peak load lasts for only a fraction of a minute. Even though the round trip may take a number of hours, the total power consumption for the series of short peaks at maximum speed, alternating with periods of no load at minimum speed, is relatively small. The drilling load (slush pump and rotary table) is usually much less than the peak load for hoisting but is a continuous load, so that the total horsepower hours consumed in drilling may be several times that for the hoisting operation. When setting casing, cementing or on a fishing job, engines may at times be idled.

From the above analysis, it will be seen that much of the engine operating hours will be at reduced speed and reduced load, so that the average load factor for the rig power plant will be low. Taking into account the loads during the various rig operations, field experience indicates that the engines behind the drawworks on a large rotary rig with 1000 installed horsepower of diesels may be loaded to about 25 or 30 percent of their full speed and full load rating, on an average of their operating time while drilling a well and on an average of various types of wells and well conditions. The load factor will vary for wells of different depths, hardness of formations, troubles of various kinds and coring. Smaller rigs may have a higher average load factor and rigs with greater installed horsepower may have a lower average load factor.

While the conditions under which a large rig may operate vary so widely that no close general estimates may be made, it has been reported that a rig with 1000 installed diesel horsepower on a very deep exploratory well has averaged 300 gallons fuel oil per day for the last 60 days, and that maximum fuel consumption on this well was 500 gallons per day when drilling at 12,000 feet with 4½-inch drill pipe. On another similar rig, when drilling an 8,000-foot well, the fuel consumption is reported to have averaged approximately 352 gallons per day or a total of 24,640 gallons for the well. With the same rig on shallower wells, under favorable conditions for the drilling operation to continue during a larger proportion of the operating time, the daily fuel oil consumption might average as high as 500 gallons or 600 gallons for the rig.

The diesel requires very little water except for a few hundred gallons sufficient for initial filling of the jackets and radiator on a given well. The subsequent loss of water while drilling, provided the sealed cooling system is kept tight, is very small. This often makes an important saving in operating costs, because in the areas of sedimentary rocks in which oil is found, the ground water and streams usually are mineralized. The streams are often muddy. In desert country water may have to be trucked a long distance, which would be costly if much water were required. The advantage of small consumption of fresh water for off-shore drilling in salt water requires no explanation.

U. S. OIL INDUSTRY NEEDS 10,000,000 TONS OF STEEL

THE American oil industry needs 7,707,900 tons of steel, exclusive of castings and forgings, to meet estimated petroleum demands in the 18-months period from April 1, 1948, to September 30, 1949, the National Petroleum Council's committee on petroleum industry steel requirements has reported, following an intensive survey and study made at the request of the United States Department of Interior. Expressed in terms of tons per year, this requirement is 5,138,500 tons needed annually for oil and gas production, oil pipelines, refining and marketing plant facilities.

The estimated steel required for natural gas transportation from the gathering systems up to the city gate equals 2,191,900 tons for the 18 months or 1,461,400 tons a year.

This makes a total of 6,599,900 tons of steel needed in one year for all oil and gas activities. In addition to these requirements, there are essential needs for allied phases of the industry's operations. These phases represent essential petroleum industry activities, but much of the steel used is charged to other industries from the standpoint of steel mill production. An example is the container requirement for distribution of lubricants in cans, drums and grease packages which are used in great quantity by the petroleum industry but which may be considered from the standpoint of steel as a requirement of the container industry. Another example is the steel going into tank cars for transportation of petroleum products. This also is an essential oil industry operation, but the steel required is charged as part of the freight car building program.

The committee report covers the requirements for these somewhat indirect but integral and essential phases of the petroleum industry. The total steel needed for containers is estimated at 1,496,600 tons for the 18-months period or 997,800 tons a year. The estimated needs for tankers, barges, tank cars and truck tanks amount to 1,120,400 tons for the 18 months or 746,800 tons on an annual basis.

In addition to the aforementioned functions, adequate consumer storage at the home and on the farm is needed to permit efficient distribution of petroleum products. The requirement for this consumer storage is estimated to be 1,340,300 tons for the 18 months or 893,500 tons a year, covering storage for liquefied petroleum gas, farmers' tanks and residential heating oil storage.

All of the foregoing estimates pertain to the activities of the petroleum industry in the United States. In addition the American petroleum industry needs 1,714,400 tons of steel to carry on its production, transportation, refining and distribution activities abroad during the 18-months period. This is equivalent to 1,143,000 tons a year.

The grand total of all direct and indirect requirements for the industry both at home and abroad is shown to be 15,571,500 tons over the entire period covered by the report. On an annual basis this is 10,381,000 tons.

The NPC committee emphasizes with respect to the requirements that the figures cover all uses of steel, whether bought direct from the steel mills by petroleum operators or furnished indirectly from the mills through the many and various suppliers, fabricators and manufacturers who handle the almost countless variety of materials and equipment ultimately to be delivered to the petroleum industry. Because of the inclusion of these many indirect requirements, the committee warns that the figures cannot be compared with published statistics on past deliveries of steel to the oil and gas industry. These total requirements, as summarized, are supported in the report in considerable detail and, in addition, individual studies cover each functional division of the industry.

When the NPC steel committee was appointed, Max Ball, director of the Oil and Gas Division of the Interior Department, wrote Chairman Russell Brown as follows:

" . . . what is required from your committee is a recommendation of the amount of steel that should be delivered by the steel mills to fabricators and consumers for use of the petroleum industry by calendar quarters, beginning April 1, 1948, and ending September 30, 1949, to enable the petroleum industry to ease inflationary pressures by bringing the supply of petroleum products into balance with prospective demand as soon as possible."

The Oil and Gas Division estimated on February 25, 1948, the total United States demand for petroleum, including exports, to be as follows:

Year	Total Demand Barrels Per Day
1948	6,250,000
1949	6,550,000
1950	6,800,000

The OGD's estimates of demand compare with actual oil consumption of 5,321,000 barrels daily in 1946, which increased by 11 percent in one year to 5,900,000 barrels daily in 1947. The estimated yearly increases for 1948, 1949 and 1950 are six, five and four percent respectively and approximate the normal growth in the use of petroleum, the NPC committee said. It pointed out that the expanding part which petroleum is taking in the national economy is apparent from the fact that actual consumption in 1947 was 62 percent greater than the average of the prewar period 1936-1939, and this consumption was met only through the use of reserve capacity built up largely prior to the war years. This reserve capacity now has been absorbed, and substantial increases in capacity are required to restore a proper balance between oil supply and demand.

Walter S. Hallanan, NPC chairman, in releasing the steel committee's report said that the continued rapid growth in consumer demands for all petroleum products which the American petroleum industry is being called upon to meet make it extremely important that manufacturers of steel promptly and continuously make available

Table I

	Total Requirements in thousands of tons, Apr. 1, 1948-Sept. 30, 1949	Requirements in thousands of tons per year
1. Steel requirements for activities of domestic petroleum industry:		
Oil & Gas Production		
Oil & gas	3,654.0	4,436.0
Natural gasoline	304.6	203.1
Sub-total	3,958.6	2,639.1
Oil Pipelines	1,646.4	1,097.5
Refining	1,363.8	909.1
Marketing		
Terminal bulk plants & service stations	611.9	408.0
IPG plant facilities	127.2	84.8
Sub-total	739.1	492.8
Total	7,707.9	5,138.5
2. Requirements for natural gas up to city gate:		
Natural Gas	2,191.9	1,461.4
3. Requirements for packaging, other transportation and home storage:		
Containers	1,496.6	997.8
Transportation (other than pipeline)		
Tankers	370.9	247.2
Barges	319.1	212.7
Tank Cars	324.3	216.2
Truck Tanks	106.1	70.7
Sub-total	1,120.4	746.8
Farm & Home Storage		
Oil	558.8	372.5
LPG	781.5	521.0
Sub-total	1,340.3	893.5
4. Requirements for American petroleum industry abroad:		
Foreign (U. S. owned)	1,714.4	1,143.0
5. Total of all direct & allied steel requirements of American petroleum industry, domestic and foreign, itemized above:	15,571.5	10,381.0

sufficient quantities of steel to be converted into the materials and equipment urgently needed by the oil and gas industry, if hardships to consumers of fuel oil, kerosene, natural gas and other oil products are to be avoided.

"In spite of the record-breaking demands for petroleum during the war and since," Mr. Hallanan said, "the known underground reserves in this country as recently estimated by authoritative sources, have substantially increased and are now the greatest in history. Consumer demands for all oils in 1947 reached an all-time high, but even the previous 1947 and wartime peaks are being topped in 1948, yet expansion of production, refining and distribution facilities continues to be retarded through lack of sufficient quantities of steel and other basic materials.

"The petroleum industry has done an outstanding job in its efforts to overcome the handicaps enforced upon it under wartime controls. Continuing lack of sufficient steel with which to manufacture additional pipe and other production, transportation and refinery equipment, as well as adequate storage facilities, particularly to meet the requirements of small distributors on the farms and in the home, has contributed substantially to the acute situation which consumers of petroleum have faced this past winter."

The steel committee is composed of Chairman Russell B. Brown, E. C. Brown, Al Buchanan, J. C. Donnell II, Fayette B. Dow, Gordon Duke, R. G. Follis, Michael Halpern, C. L. Harding, D. A. Hulcy, H. L. Hunt, Ardon B. Judd, Harry J. Kennedy, J. Howard Marshall, N. C. McGowen, Claude P. Parsons, A. W. Peake, Frank M. Porter, A. H Rowan, W. G. Skelly, John R. Suman, J. Ed Warren and Henry E. Zoller.

Table I summarizes the requirements for the American petroleum industry in the United States and abroad.

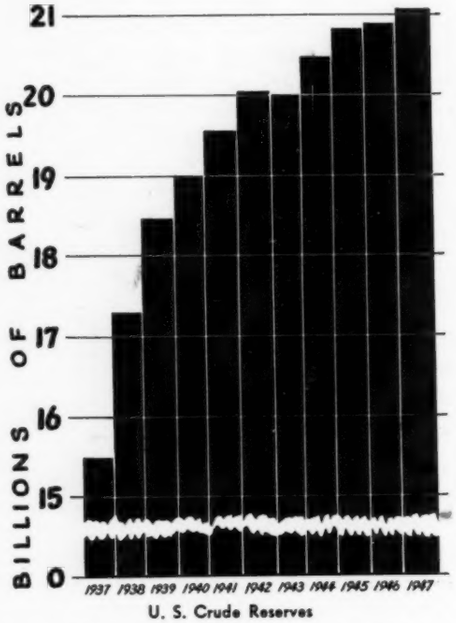
THREE PERCENT RISE IN KNOWN RESERVES

ACCORDING to the report of the reserves committee of the American Petroleum Institute, of which F. H. Lahee of Sun Oil Company is chairman, additions to the known reserves of crude petroleum in the United States during 1947 were 2,464,570,000 barrels. Despite withdrawals the highest of record, amounting to 1,850,445,000 barrels, this left a net addition to known reserves at the beginning of this year of 614,125,000 barrels, bringing the total as of Dec. 31, 1947 to 21,487,685,000 barrels.

Since 1946 the committee, in cooperation with the reserves committee of the American Gas Association, has added to its crude oil estimate a calculation of the known reserves of natural gas in order to give a better view of the country's liquid hydrocarbon resources. Natural gas reserves at December 31, 1947 were estimated at 165,926,914 million cubic feet, an increase of 5,351,103 million cubic feet over the year preceding and equivalent to 3,253,976,000 barrels of liquids. Including this figure the total known reserves of liquid hydrocarbons as of December 31, 1947 stood at 24,741,660,000 barrels, a gain of 704,881,000 over December 31, 1946.

Statistics of the changes in crude petroleum, natural gas liquids and total liquid hydrocarbons are given in Table I (a), (b) and (c), accompanying.

As in other recent years the additions to known reserves have resulted mainly from the extension of old pools, these accounting for slightly over 50 percent. Additions from discoveries of new fields amounted to some 20 percent, the remainder coming from revision of previous estimates.



U. S. Crude Reserves

The greatest increase in oil reserves during 1947 was made in Louisiana, followed in order by Texas, Wyoming, Colorado and Oklahoma. These five states accounted for 72 percent of the total gain, and the appearance of Colorado and Wyoming in the list attests the growing importance of the Rocky Mountain district as a producing area. Oklahoma was responsible for the greater part of the increase in natural gas liquids, 87 million barrels out of a total of 91 million.

The growth of known crude oil reserves from 1936 to 1947, the period for which statistics are available, is shown in Table 2. As no computations of natural gas reserves have been prepared except for the past two years, it is impossible to make a similar comparison for reserves of all liquid hydrocarbons.

Table II

Proved Reserves, Crude Oil

1937 - 1947

(Barrels of 42 U. S. Gallons)

Year	Estimated Proved Reserves, Year-End	Increase over Previous Year
1936	13,063,400,000	—
1937	15,507,268,000	2,443,868,000
1938	17,348,146,000	1,840,878,000
1939	18,483,012,000	1,134,866,000
1940	19,024,515,000	541,503,000
1941	19,589,296,000	564,781,000
1942	20,082,793,000	493,497,000
1943	20,064,152,000	—18,641,000
1944	20,453,231,000	389,079,000
1945	20,826,813,000	373,582,000
1946	20,873,560,000	931,714,000
1947	21,487,685,000	614,125,000

Table I
American Petroleum Institute Estimate of Reserves
(Barrels of 42 U.S. Gallons)

	CRUDE OIL		(b) NATURAL GAS LIQUIDS		(c) TOTAL LIQUID HYDROCARBONS
Total proved reserves as of Dec. 31, 1946		20,873,560,000		3,163,219,000	24,036,779,000
Revisions of previous estimates	+ 749,278,000			+ 2,211,377,000	
Extensions of old pools	1,269,862,000		+ 192,237,000	251,538,000	504,731,000	2,716,108,000
New reserves (new pools) discovered in 1947	445,430,000		59,301,000		
Proved reserves added in 1947		2,464,570,000			
Total proved reserves as of Dec. 31, 1946 plus new proved reserves added in 1947		23,338,130,000		3,414,757,000	26,752,887,000
Less production during 1947		1,850,445,000		160,782,000	2,011,227,000
Total proved reserves of crude oil as of Dec. 31, 1947		21,487,685,000		3,253,975,000	24,741,660,000
Increase in crude oil reserves since Dec. 31, 1946		614,125,000		90,756,000	704,881,000

THERMAL - TO - SUSPENSOID CONVERSION FOR THE SMALL REFINERY

By Robert L. Purvin*

General view of Suspensoid catalytic cracking unit.

THE Suspensoid cracking process was developed in Canada by the technologists of Imperial Oil, Ltd. for producing high-octane gasoline and large quantities of butylene at a low capital investment. In developing Suspensoid, it was desired to use existing thermal cracking facilities to the maximum extent, reducing to a minimum the new equipment required and keeping down additional operating costs. It was found that by adjusting the coil conditions in the present thermal equipment to insure complete vaporization of the gas oil charged to the unit, a substantial catalytic effect could be obtained by injecting relatively small amounts of a catalytic type clay, such as Super Filtrol, into the furnace feed.

Suspensoid catalytic cracking has been in operation at the Sarnia refinery of Imperial Oil, Ltd., for the last eight years. Four 5,000-bbl. tube and tank type cracking units were first converted to Suspensoid, and later, in 1942, a 5,000-bbl. unit was constructed specifically for Suspensoid operation. Conversion of a thermal unit to Suspensoid is relatively simple, since the operation differs from vapor phase thermal cracking principally in that catalyst is injected into the charge to the coil and the spent catalyst removed from the fuel oil after it leaves the evaporator.

Studies have been made of numerous small refinery set-ups, and it is concluded that a thermal coil with 1,000 to 4,000 bbls. capacity can be revamped for Suspensoid operation for only a fraction of the cost of a new catalytic cracking unit. Necessary changes include catalyst injection equipment, fuel oil filtration equipment, and alteration to the coil to render it suitable for Suspensoid operation. No expensive regeneration apparatus is required if relatively inexpensive catalytic clays, such as Super Filtrol, are used, because only small quantities are required on a once-through basis.

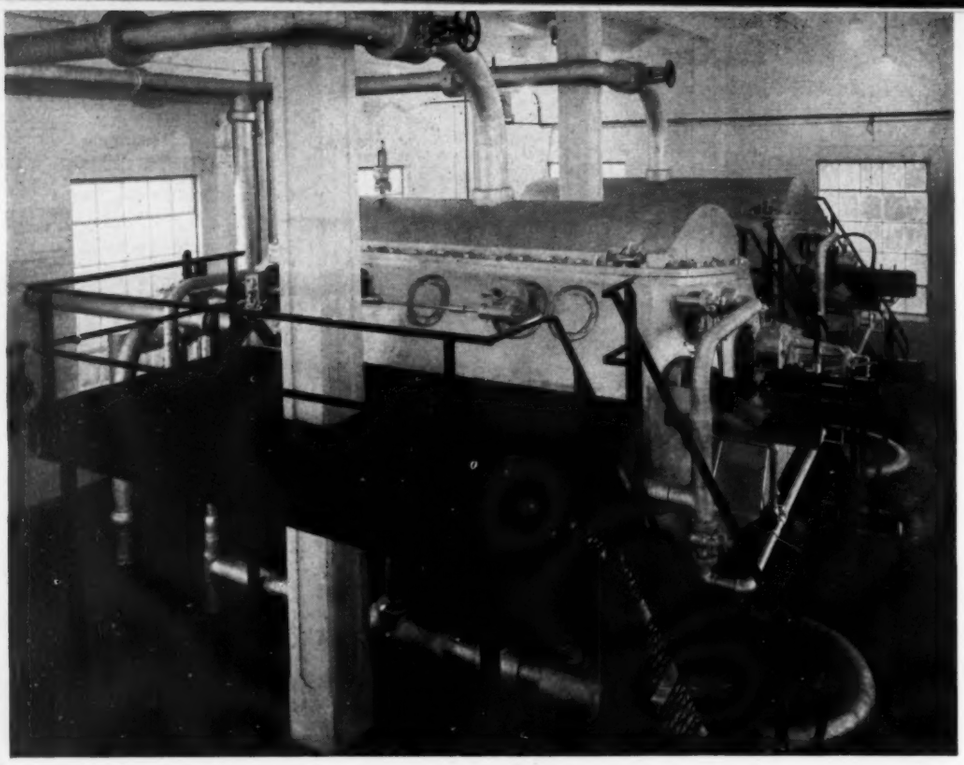
A wide range of gas oils may be charged to the unit, and heavy naphtha, admixed with gas oils and processed in the Suspensoid operation, is reformed to a gasoline with an octane number approximately the same as the pressure distillate from the gas oil. Studies on the latter type of operation indicate a five percent greater yield than that obtained when Suspensoid gas oil cracking and thermal reforming are carried out separately. Strangely enough, Suspensoid reforming has little or no advantage over thermal reforming of heavy naphthas, possibly due to the catalytic activity of clay being overshadowed by thermal influences with increases in temperature above 1090°. The combined operation, however, is of importance to the small refiner who has no facilities for reforming heavy naphtha and must, therefore, work off this low octane fraction into gasoline, solvents or kerosene.

Since the operation was begun, the Imperial technologists have been studying and improving the process. Specialized equipment has been developed and operating techniques worked out. It has been established that the clay serves not only as a catalyst but also prevents coking of the coil at the high temperatures maintained in the operation. Non-catalytic solids would not permit as high an operating temperature, and the product quality would not be as good. The best operation is obtained at the maximum pressure and the minimum temperature consistent with the maintenance of complete vaporization in the coil. In view of this fact, the addition of naphtha or water can be used to permit complete vaporization at a lower temperature and higher pressure. Naturally, where naphtha is available, it is the preferred additive, since the octane number improvement of this stock is generally desired. Water has been used experimentally also for controlling linear velocity and V/V/hr. in the coil to obtain optimum operation.

The average thermal coil operates at a conversion per pass of from 10 to 25 percent. Due to the higher operating temperature and the catalytic effect of the clay, the conversion per pass in Suspensoid operation is very much higher. As a result of this higher conversion, the quantity of recycle is reduced considerably, and this tends to balance the volume throughput and the heat requirement. It is for this reason that a thermal coil can be converted relatively easily from thermal to Suspensoid, and in some cases it should be possible to increase the fresh feed to cracking with Suspensoid.

In converting a thermal coil to Suspensoid, it is principally a matter of adjusting the number of tubes to secure the proper V/V/hr. through the coil; and in the case of a unit with a reactor, of by-passing this piece of equipment. Since the operating temperatures in Suspensoid

* Consulting Engineer, Dallas, Texas



Rotary filters used for removing spent catalyst from cracked fuel oil.

3555 B/D Refinery Clean Coil Cracking Only
Reduced Crude Quenching (Without Polymerization)

Crude Breakdown	Percent	Thermal B/D	Percent	Suspensoid B/D
St. Run Gasoline	25	890 (330 EP)	20	700 (300 EP)
Naphtha	3	105	8.5	300
Kerosene	7	245	6.5	230
Reduced Crude	64	2285	64	2285
Loss	1	35	1	35
Cracking Stock				
Reduced Crude (Uncracked Resid, 285 B/D)		2000		2300 (inc. heavy naphtha)
Products				
PD 10#	58.5	1170	62	1430
Fuel Oil	33.7	675	25	580
Excess Butane	1.0		4	
Gas	4.8	650,000 cu. ft/D	7	1,500,000 cu. ft/D
Loss	2		2	
Gasoline Quality, 10# RVP				
St. Run Gasoline, 330° EP	62	(Motor O.N.)		
St. Run Gasoline, 300° EP			65	(Motor O.N.)
PD, 400° EP	63.5	" "	72	" "
PD, 1.5 cc TEL	74	" "	81	" "
Finished Products	**Motor**	**Research**	**Motor**	**Research**
Ethyl, 1.8 cc TEL*	78.5	79.5	82	88
Regular, 1.5 cc TEL**	74	78.5	78.5	84.5
U. S. Motor, 60 B/D				

* Quantity of thermal product 1000 B/D; Suspensoid 2130 B/D. For thermal case, Ethyl is composed of 90-100 percent St. run stock. Three cc's of TEL will not bring 400 EP PD to 78.5 (Motor) O.N.
** Suspensoid regular requires 0.85 cc TEL to reach octane values shown. Quantities are the same.

range from 1040° to 1080°, the last 10 to 15 percent of the tubes in the radiant section should be four to six percent chrome and one-half percent molybdenum. In existing units containing a considerable amount of heat exchange between evaporator and/or bubble tower vapors and fresh feed and/or crude, adjustments are necessary to maintain the heat balance, since the recycle with Suspensoid is considerably less.

Clay slurry, prepared from a portion of the bubble tower bottoms, would be introduced into the charge as it enters the furnace. The slurry would be injected by means of a positive displacement proportioning-type pump, especially designed for this process by Imperial Oil, Ltd., and National Transit Pump Company. Approximately two pounds of catalyst per bbl. of coil charge would be required.

The temperature and back pressure on the furnace would be adjusted to insure complete vaporization in the outlet stream, and water may be injetcted in the coil charge to allow some flexibility in controlling the linear velocity, the V/V/hr and the required temperature and pressure. The coil outlet temperature would be in the range of 1040 to 1080, and the back pressure 400-500 psi. The vapor stream from the furnace would be quenched with fresh gas oil feed, reduced crude or cycle stocks, before passing through the pressure release venturi, which is a choke sized for the flow and conditions to maintain the required back pressure on the coil while the quenched stream flashes into the evaporator at a lower pressure. This type of release mechanism has been found quite satisfactory in withstanding the relatively great abrasion resulting from the flashing slurry. The temperature and/or quantity of the quenched stream would be used to control the temperature in the evaporator. The evaporator and bubble tower operations would be similar to those in thermal cracking. The fuel oil removed from the evaporator would be stripped of light ends and cooled to approximately 500°. All of the clay injected into the cracking coil charge is contained in this fuel oil slurry and is removed by means of an Oliver Precoat rotary filter. Since all of the salts and powdered coke are removed along with the clay, the filtered fuel oil is of a particularly high quality. Spent clay discharged from the filter is discarded; however, since this clay is coated with low gravity fuel oil, it makes a fairly good fill and has been successfully used as such.

As in all new processes, many problems arose during the early days of the development. Erosion of the coil and the release valve was one of the early problems, but by proper design of headers and by control of operation conditions, erosion in the coil is no longer a major problem. The substitution of the venturi choke for the release valve also eliminated this phase of the problem. Early difficulties connected with filter and slurry pump operations have been eliminated by new developments in equipment and operating techniques.

Studies on the effect of varying amounts and types of catalysts have indicated that even spent clay (Super Filtrol) from lube contact filtration is sufficiently active to produce reasonable results at two pounds per barrel of coil charge. French Super Filtrol is more active. As long as spent clay is available, however, the use of fresh clay is not warranted. Synthetic catalysts are considerably more active than Super Filtrol, but their cost makes them impractical for the once-through operation. When fresh Super Filtrol is used, the catalyst cost in the Suspensoid operation would be between four and five cents per bbl. of fresh feed. Currently the research and development division of Imperial Oil, Ltd., under the direction of Dr. R. K. Stratford, is studying the effect of varying the quantity and activity of the catalyst and the effect of varying the blend of charge stocks. A catalyst regeneration system is being developed suitable for this type of operation when synthetic catalysts are used.

Operating data from both the main Imperial Oil cracking units and the pilot Suspensoid coil at the Sarnia refinery show that the yield of gasoline from Suspensoid is comparable to that obtained in thermal and catalytic cracking methods. An octane number improvement above thermal of seven to eight points on motor method and 11 to 12 by the research method has been shown from the Imperial operation. The lead susceptibility is only 10 to 15 percent less with Suspensoid than with thermal and compares favor-

ably with the other catalytic cracking processes. As would be expected, the fuel oil yield is considerably less and the light ends yield considerably greater with Suspensoid than with thermal, but the increase in product volume is not as great as in the Fluid catalytic cracking process, for example.

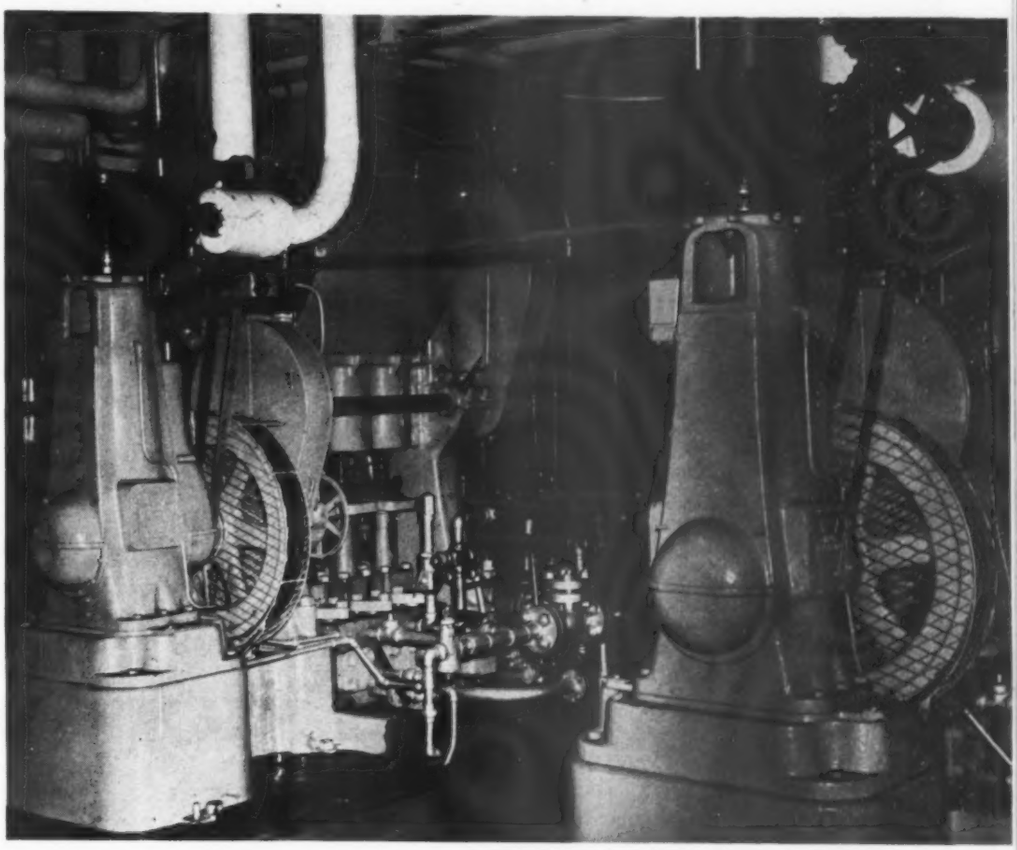
As in the other catalytic methods, the yield of excess butylenes is greater than with thermal, and a considerable additional yield and octane number can be obtained in combination with a non-selective polymerization operation.

To give some idea as to the effect of Suspensoid in a small refinery, the accompanying table has been prepared comparing the thermal and Suspensoid operations in a typical small skimming and cracking unit operating on Mid-Continent crude oil. It will be noted that the cracking operation is clean coil only, with reduced crude being used to quench the coil discharge. It has been assumed throughout that no gasoline is produced from the quenching operation and that the residuum passes directly out of the system into the fuel oil with only some vis-breaking. Thus the coil charge consists of cycle gas oil plus the virgin distillate from the reduced crude. It will be noted that a large heavy naphtha cut can be utilized in Suspensoid with an overall increase in gasoline yield and product quality. The actual crude breakdown will, of course, depend on the existing market conditions. It will be noted further that the increased gas and excess butane are derived from the fuel oil, and in those refineries purchasing expensive natural gas or burning some of their own fuel oil, this trade does not debit the operation.

The difference in estimated operating costs between thermal and Suspensoid amounts to less than one-half cent per gallon of gasoline produced, which is more than offset by the upgrading of stocks and by the reduction in lead tetraethyl required. On the present-day market requirement of 78.5-74 motor method octanes for Ethyl and regular, respectively, the process would show only a fair payout, but in the anticipated market requiring 82-77, the payout becomes very attractive. It should be explained that the apparent increase in gasoline yield with Suspensoid is due to the higher recovery from naphtha reforming in the operation. If non-selective polymerization had been included, the gasoline yield would have been increased by approximately four percent and the octane number of the PD increased to approximately 74 (unleaded motor method octane number).

It is necessary that each refiner's situation be studied individually with regard to the advantages to be obtained from the Suspensoid operation, but in general it can be seen that a competitive position may be maintained by the application of this process to existing thermal cracking equipment. The process allows flexibility of charge stocks and product quality, and is worthy of careful consideration by those refiners who wish to keep down capital investment and yet continue to produce competitive products.

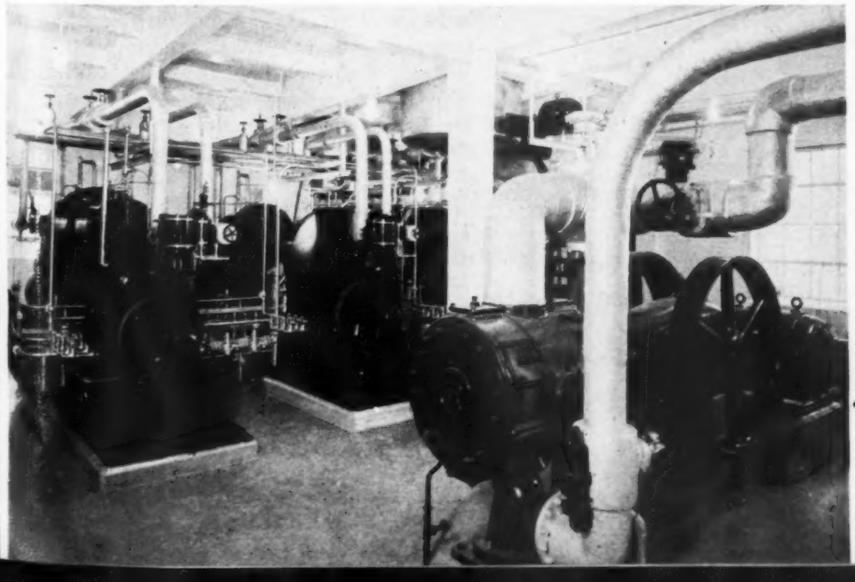
The Standard Oil Development Company is prepared to grant licenses under its patents on the Suspensoid catalytic cracking process at reasonable terms.

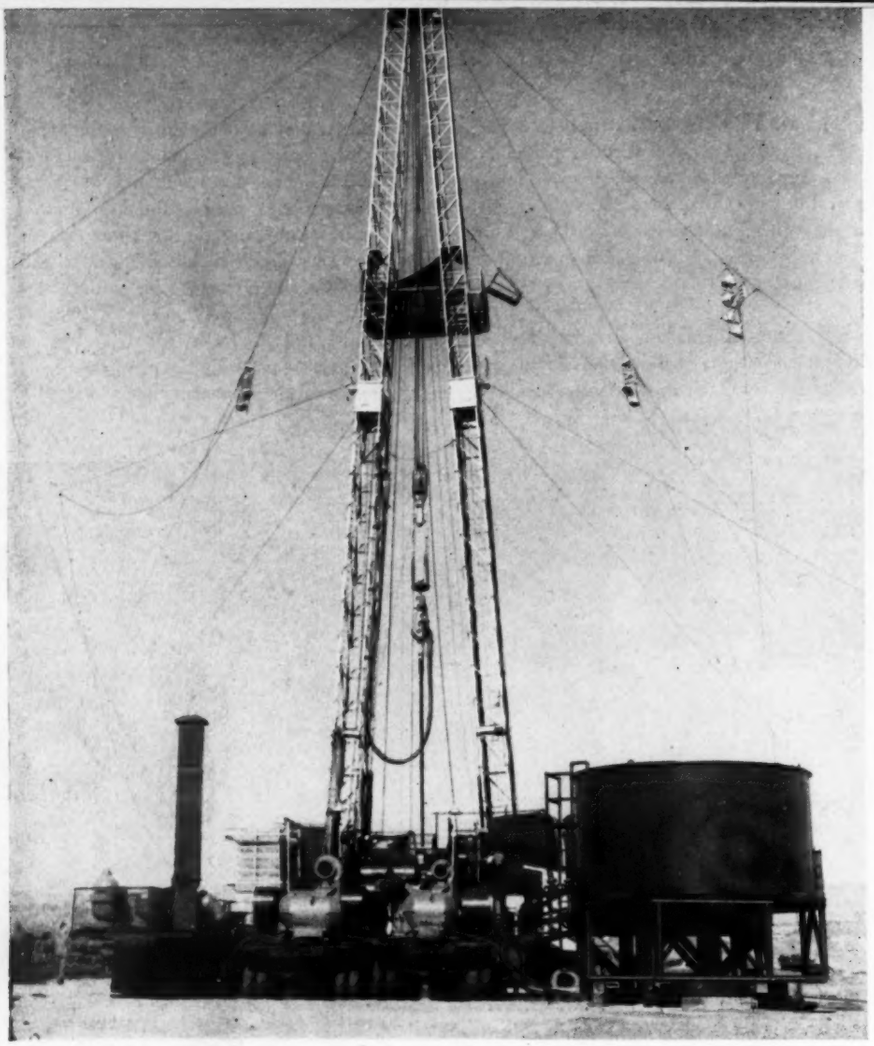


Pumps for injecting catalyst into coils.↑

Catalyst hoppers in slurry preparation section.→

Gas compressor for pressure filters in foreground, catalyst slurry pumps in background.↓



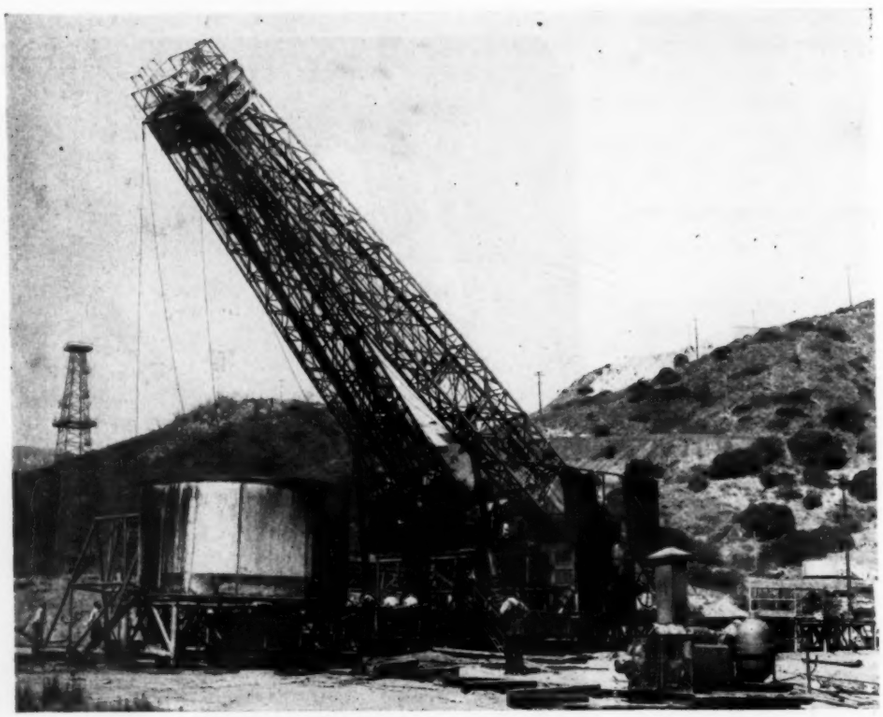


Portable electric rig ready for operation. Stack at left provides gas-free air for motors and ventilation under derrick floor.

MUCH interest has been aroused in a new drilling rig developed in California for Shell Oil Company after two years and $250,000 spent in its design and construction. The unit has been built to combine complete mobility with sufficient power to drill to 10,000 feet. While the first cost of the rig is 25 percent greater than one of conventional design, the saving in moving time and cost is expected to offset the difference in a relatively short time.

To attain the objectives of compactness and portability, many new features were incorporated in the equipment. The derrick, designed by Waldrip Engineering Company, is a twin mast which extends to a height of 123 feet, weighs 18 tons and has a load capacity of 300,000 pounds. When collapsed for transportation, the derrick is reduced to dimensions of 8 x 8 x 68 feet. The derrick is extended and telescoped by means of two electric motors driving sprockets through worm gears. The motors are mounted in the base of the upper section of the derrick, and the rotation of the sprockets raises the section on chains mounted in the lower section, while the worm gear acts as a brake and holds the upper section in position if the power is turned off. The derrick has a 16-foot spread between the legs and the tubing platform and permits the racking of 10,000 feet of 4½-inch pipe.

PORTABLE ELECTRIC RIG PRESENTS NEW



A radical departure in arrangement was adopted in order to install the Emsco JA-1000 drawworks at truck height. The derrick floor is elevated to a height of 11 feet 6 inches and the drilling mechanism is placed beneath it. This necessitated the development of remote controls and the raising of the catheads on a special shaft several feet above their normal position. Clutch control is provided by the use of air clutches, and a high-pressure boosting pump with valves that regulate the pressure applied to brakes simplifies brake operation. Operation of the electric motors which govern the hoisting and rotary tables is regulated through hydraulic controls. Thus all drilling operations are centered at a control board at the side and rear of the derrick floor. Sitting at this board the driller is able to direct all principal activities with a minimum of effort.

The drawworks is mounted on a permanent turntable with the pivot point of the latter at the

Eighteen-ton derrick telescoped and being prepared for moving.

center of gravity of the former. When the rig is being moved from one location to another, the drawworks is in a longitudinal position. On arrival at a drilling site, the truck backs into a prepared position between two parallel truss subbases; the drawworks is rotated 90 degrees on the turntable; hydraulic jacks and trusses built into the subbases lift the turntable and drawworks clear of the truck which then pulls away; the whole mechanism is lowered to the support of adjustable legs which are let down from the turntable base, and the drawworks is in position without the use of cranes or other outside equipment. In moving out the process is simply reversed.

In order to permit the use of lightweight bases, it was necessary to find some other means of supporting the weight of racked pipe during bit changes and of the rotary table with its load of suspended drill pipe. The problem of racking was settled by stacking the pipe on the ground instead of inside the derrick. A steel chute pivoted near the table extends to the surface of the ground. The bottom of the chute is movable in any direction by jack screws driven by remote-control hydraulic motors.

The weight of the rotary table and its string of pipe is supported on the drilling riser, taking the load into the cellar through the blowout preventer and other portions of the drilling riser. Special cylindrical guides fixed to the drilling riser position the table and transmit all torque loads to the drilling riser, and the torque in turn is passed on to the bases by means of tie rods. The drilling load encountered while drilling surface hole, before the blowout prevention equipment is installed, is carried on the truss base. The cylindrical rotary table guides, in conjunction with the independent rotary table drive, make it easy to remove the table while setting surface casing or when other special operations require clearance to the hole.

The drilling base is constructed of two longitudinal truss sections approximately 4 x 4 x 45 feet and two cross truss sections 5½ feet wide and 7½ feet tall on the ends and with five-foot deep truss sections, 24 feet long. The two cross-truss sections are placed five feet apart which provides the derrick with a 16-foot wide by 30-foot long floor. By reducing the central section of the cross truss section to 4½ feet in depth, it is possible to obtain an 11½-foot-high derrick floor and yet maintain 7-foot headroom under the drilling floor.

The bases are equipped with conical self-aligning pins and sockets to insure perfect alignment with a minimum of trouble. The longitudinal bases are set parallel and in the proper location with respect to the hole center, and the cross-truss sections are then set in place guided by the conical pins. All drilling, plumbing and electrical connections are carried from the longitudinal bases to the cross base and thence to the derrick by means of quick acting couplings. Rapid assembly of unions and fittings is assured by this positive method of lining up the respective sections of the base.

The left-hand longitudinal base carries the fluid pump, electric motor and fluid reservoir tank. This unit supplies the power to the drill pipe racking chute hydraulic motors. The same power is used for operating the hydraulic jacks required in locating the drawworks and the hydraulic rams used to raise the derrick to the vertical. It can be used in an emergency to supply power to the drawworks hydraulic brakes and other hydraulic controls. This same section of longitudinal base also contains the stand pipe manifolding.

The right-hand longitudinal base contains an air receiver, and it is used to support the removable mud ditch.

The rotary table is driven by a 250 HP direct-current electric motor which is located below the derrick floor and between the transverse bases. The drive from the motor to the table is by means of a drive shaft equipped with universal joints. The table itself is set almost flush with the derrick floor, and the lock pawls are remotely controlled by air from the driller's control desk. The use of a separate rotary table motor provides the crew with a derrick floor clear of guards, and it allows the drawworks motor to remain idle while rotating.

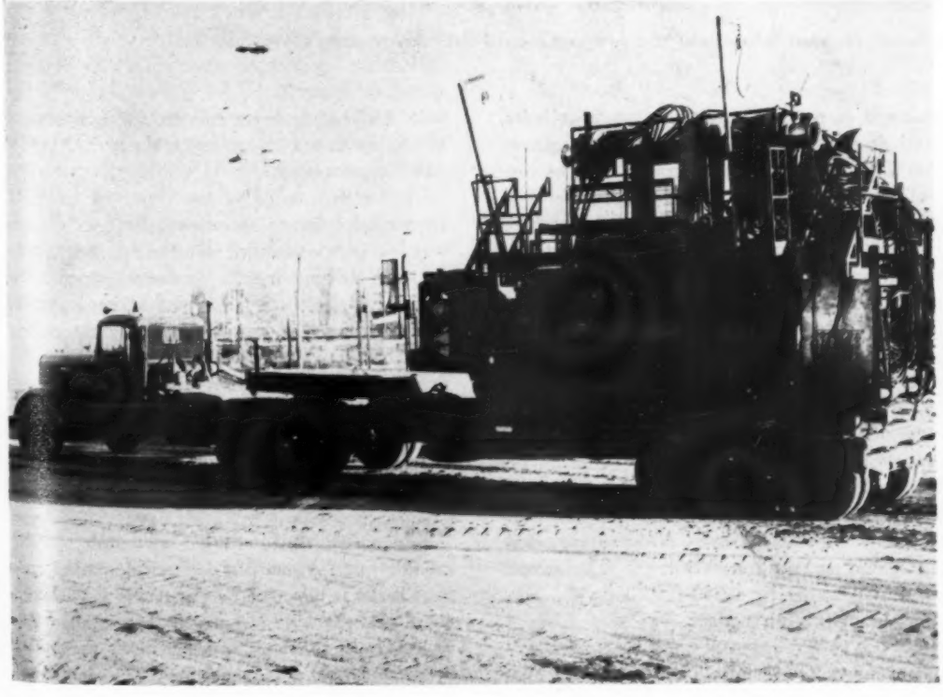
Two slush pumps with their entire drives, one double mud tank, one chemical tank, three internal combustion engines and generators, the change house and the drawworks speed selection transmission and drawworks motor are all mounted on wheels. The only units not permanently mounted on either full- or semi-trailers, in addition to conventional tanks and racks, are the mast, which is moved as one piece; the drawworks, which has special loading equipment, and the four-piece subbase, which can be moved on a single semi-trailer.

The slush pumps and their drives are the first major pieces to be moved away from the location when moving out and the last to be located when rigging up at a new location. These items have been mounted on full trailers that can be moved by any handy truck and which can easily be disconnected and set to one side while waiting for the balance of the equipment to move. The pump trailers are built as a part of the pump frames, and they are low slung. Eight 10 x 15 tires carry the load and there is only about 12 inches road clearance.

The generators and their prime movers are located out of the way, and they can be moved at almost any time. They are mounted on two semi-trailers as it will generally be possible to convey them in one continuous move directly from the old to the new location. They are carried on two-axle semi-trailers supported on eight 8.25 x 15 tires.

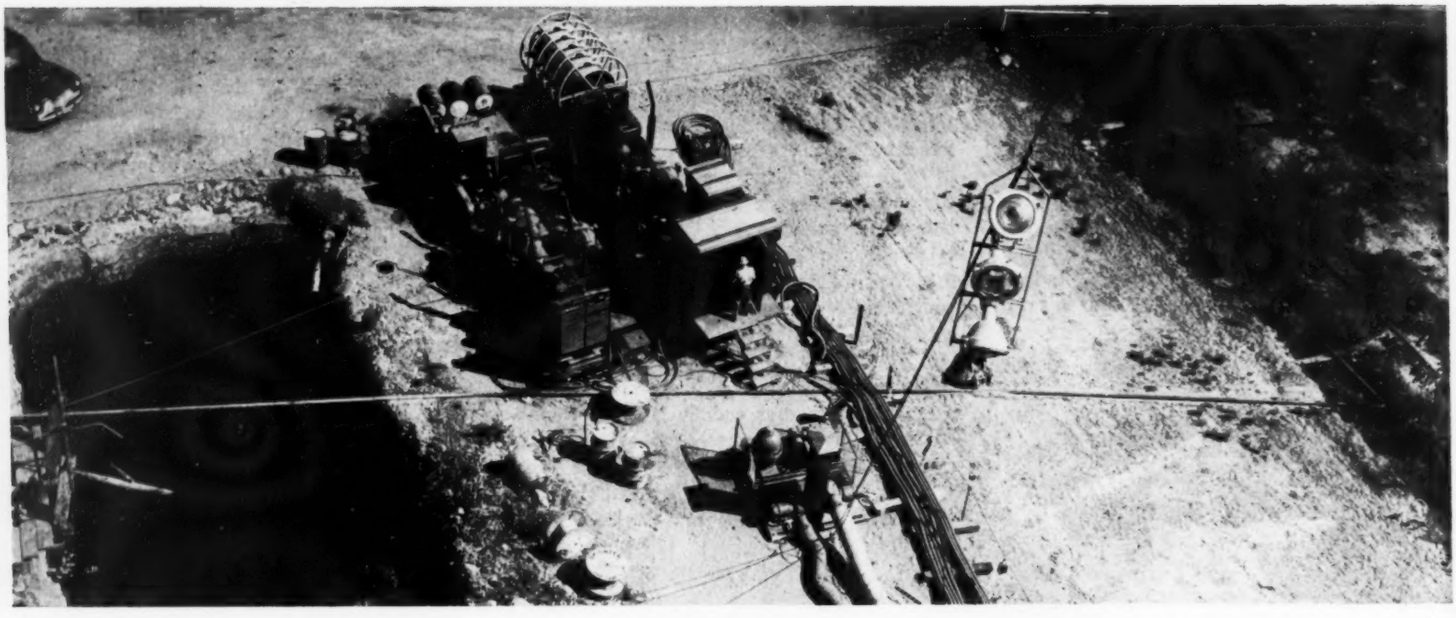
The drawworks motor and selective speed transmission are mounted on a three-axle trailer that also includes the cable terminal board and electrical instruments and controls. This trailer is four feet high at the top of the base supporting the transmission, and hinged extensions are in-

FEATURES



Drawworks, complete with walkways, stairs and raised catheads, all mounted on the turntable for transportation on a 3-axle semi-trailer.

Winding up the electrical cables on specially designed reels for transportation to a new location.



Power plant as viewed from the top of the derrick. The plant includes three 12-cylinder engines and three direct current 200 kw generators.

stalled on each side of the trailer. When these hinged extensions are lowered, they form a platform that closes the openings between the trailer and the longitudinal bases. All nonoccupied floor space on this unit is covered with light weight, open-mesh steel flooring. Twelve 9 x 20 tires carry the load of this unit.

The double mud tank used as a pump suction tank is unique in that it is mounted on a single trailer axle to form a semi-trailer. This unit is made with the bottom of the tank supports about four inches off the ground. Steel beam sections are hinged to the bottom of the trailer in such a way that they can be swung under the tank for support. When the tank is empty and the front end is raised onto the fifth wheel of a tractor truck, the combination of fifth wheel lift and rear trailer spring lift clears these steel supports, and they can be swung up out of the way.

The prime movers and electric generators are mounted on two semi-trailers. One 12-cylinder, Hall Scott natural gas engine, its Westinghouse 200-KW direct current generator and the control panel are mounted on one semi-trailer. The other two 12-cylinder engines and their 200-KW generators, along with two air compressors and their electric motor drives, are mounted on the other semi-trailer.

Each of the three direct current generators are rated at 200 KW 395 volts, 506 amps. at 1450 rpm. with separate excitation from a 15-KW generator mounted on the frame of the main generator.

The larger of the two slush pumps is powered by a 400-hp, 395-volt, 820 amp. direct current electric motor operating at 900 rpm. The second pump is powered by a 250-HP, 395-volt, 510-amp. direct current motor.

The drawworks is powered by a 500-HP, 395-volt, 1,020-amp. direct current motor operating at 750 rpm. and the rotary table by a 200-HP direct current motor.

In normal hoisting operations all three generators will be compounded into the drawworks motor. In drilling it will be customary to compound two generators into one or both pumps, and the third will furnish power to the rotary table motor. When power is required on the drawworks while drilling, the driller will cut one of the generators from the pumps and divert its power into the drawworks motor. These changes can all be made by the driller at the control console on the derrick floor.

There are three interesting electronic devices on this rig. Wynamatic Corporation eddy current brake is mounted on the drawworks drumshaft, and the wide range of braking control obtained from this unit together with the safety features of air clutches remove any danger of

failure or improper adjustment of the remote controlled drawworks brake.

A second Dynamatic Corporation eddy current device is used to control the rate of penetration and to regulate the weight of the bit on bottom. This electronic controlled, dynamatic coupling is located on the selective transmission trailer. The drive back from the drawworks is through the conventional driving chains and through the electric motor into a 20.4 to one gear increaser, which gives an overall reduction of 1.000 to one between the drumshaft and dynamatic coupling. The dynamatic coupling is mounted on the output of the gear increaser, and by controlling the intensity of current in the coupling, it is practical to control the rate of feed-off or the torque on the drumshaft which controls the weight carried on the bit.

An Ethco electronic weight indicator is also used. This device reads the hood load through an electric strain gauge located in the traveling block clevis. The gauge picks up its indication of weight from the elongation of the gauge. This strain indication is transmitted by electrical cable to an electronic box located near the control panel on the selective transmission trailer. A 1,000-cycle, alternating current, full bridge system is used, and voltage can be regulated to within two volts over a range of from 95 to 130 volts. The power to the system is supplied from 110-115-volt, 250-watt, 50-60-cycle alternating rig system.

The electronic system makes it possible to read the weight indicated on a dial calibrated in equal divisions for all weights. On the indicator used on this rig 1/10-inch dial spacing equals one-ton hook load. The load indicated by this gauge is independent of the number of lines strung or the size of line, as it is a direct reading of the hook load.

Two slush pumps are provided with this rig. A 7¼ x 12-inch triplex pump is mounted on another trailer with 400 HP motor and a 7¾ x 16-inch pump is mounted on another trailer with the 250 HP motor. The entire slush pump drives are permanently mounted on their own trailer. The frame of the triplex pump is an integral portion of the frame of the trailer. The units are assembled so the pump, motor and V-belt drives and guards are of legal width for road transportation.

Connections from the pump to the mud suction tank and from the pump discharge to the mud manifolding system are through quick-acting couplings. The suction line contains an offset connection, sliding tank section and Dresser coupling. The discharge lines contain ball joints. This construction allows the drilling crew between six and eight inches misaligment in three directions between the pump trailer and the mud tank.

Both pumps have flooded suctions and a suction line less than two feet in length. The mud tank unit includes dual manifolding of the discharge lines and flexible connections through ball joints to all derrick base lines. Quick opening and large volume gates allow the crew to clean or empty the mud tank with little lost time.

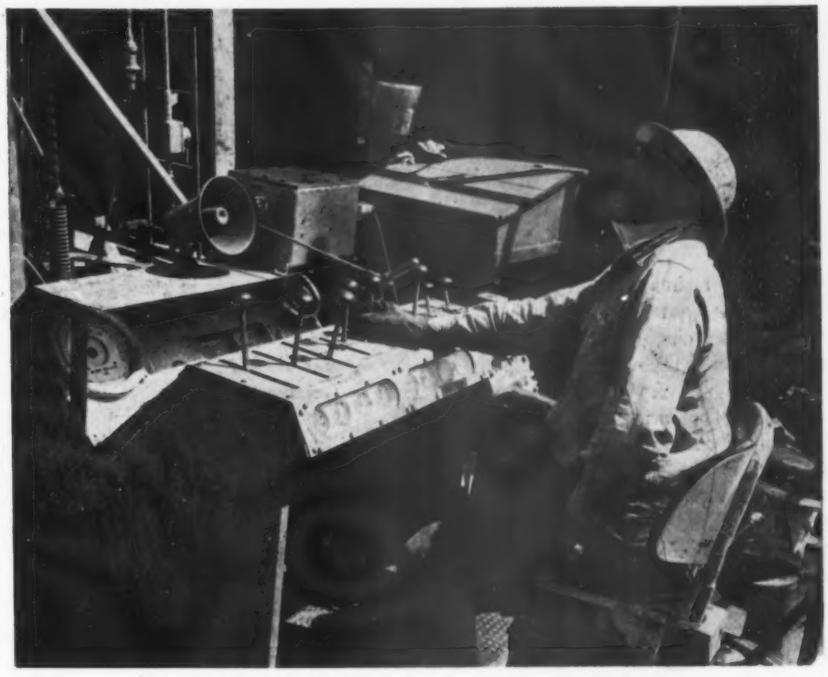
Foot-operated valves are used on the flooded suction of each pump. The connection between the mud ditch and the mud tanks is by means of section of canvas ditch about three feet long. This canvas ditch is supported on steel hoops which slide on guides. Misaligment between the mud ditch and the tank is taken up in this section.

The mud tank is divided so that each pump has its own section and an inside mud ditch diverts the returning mud into either section. This allows the crew to mix chemicals into the mud or condition the mud in one section of the tank while the other section is supplying mud to the main circulating pump.

Portability of the outfit is provided by seven Fruehauf trailers. A three-axle trailer supports the automatic driller with motor, the drawworks motor, the sand reel, weight indicator and operating mechanism. Two semi-trailers support the generators. Slush pumps are mounted on two, a chemical tank on one and a double mud tank is on another. The "dog house," or change unit, is on an eighth trailer, but this is not a functional part of the drilling rig.

When drilling is in progress, except for derrick and drawworks, the entire assembly rests on trailers with tires in contact with the ground. Shell engineers say the units were put on wheels to facilitate quick movement. A line assembly is used for setting up and operating.

The mud pumps are last in so they come out first. This reverses the usual method. The semi-trailers, coupled to tractors, can be shuttled into position as desired and the tractors released. When setting up a steam rig, as many as 23 trucks and trailers may be required. With the new electric rig, all can be moved as seven separate "packages."



Driller's console showing compactly placed controls.

Derrick being made ready for transportation to a new location.

PROGRESS OF FIELD UNITIZATION

By Dr. O. W. Willcox

HOPE of maintaining adequate oil reserves in the united states lies in (1) the discovery of new oil reservoirs, (2) intelligent operation of existing flush reservoirs by efficient primary methods of recovery and (3) recovery of residual oil by appropriate secondary methods. Exhaustion of domestic reserves can be delayed by increased imports of foreign oil and by utilizing the enormous reserves of coal and oil shale from which petroleum materials may be obtained, but the question here is of full utilization of natural petroleum which is still the cheapest source of gasoline, fuel oil and lubricants.

Of the two means for assuring maximum recovery of underground oil—intelligent operation of flush reservoirs by primary measures and recovery of residual oil by secondary measures—the former is the more important in the sense that wherever it is done, it should be unnecessary to resort to secondary methods at all. To put it another way, if present techniques had been developed and used to the fullest extent from the time of discovery, no substantial amount of recoverable oil would have been left for secondary operations.

Intelligent operation of an oil reservoir means that it should be operated at a unit, and unit operation means that all property interests in the reservoir should be consolidated and put under the direction of a single operating agency. The old "Law of Capture" is thus supplanted by scientific methods under which wells are flowed at a rate that will reduce entrapment of oil by advancing water to a minimum. Instead of wasting the gas which comes up with the oil, it is forced back into the sand for the double purpose of keeping up the pressure that brings the oil up through the well, and for preventing encroachment of water. The result is that all displacable oil is brought to the surface, the productive life of the reservoir is prolonged, every proprietor gets his due share of the profits and participates in the revenue from the field up to the day when the last well (which may or may not be on his property,) ceases to yield oil. He obtains a greater profit both because the field yields more oil and because unit operation makes it possible to produce every barrel at a lower cost than can be done by uncoordinated effort.

The law of capture, which still persists in some oil states, was outlawed nearly 50 years ago by a decision of the United States Supreme Court in the case of the Ohio Oil Co. vs. Indiana, which unanimously upheld an Indiana law designed to prevent the waste of oil reserves. This decision laid down these principles: the rights of the possessors of property lying above an oil reservoir are coequal; every such proprietor has a right to enjoy the use of the oil under his land, and he may not be deprived of this right by actions of a neighbor who proceeds in such a way as to obtain for himself an undue proportion of the common reserve to the detriment of other owners; the state has the right to protect these correlative interests, and, moreover, it has the further right to prevent waste of the products of the reservoir as a means of protecting the interests of the public in these products, and is warranted to use its police powers to that end.

Under this decision the law of capture has no standing as far as concerns the Constitution of the United States, and all states are, and for nearly 50 years have been, free to use their police powers to prohibit practices that result in waste of national resources and damage to correlative rights.

Despite this ruling the states have been slow to make use of the powers that the Supreme Court recognizes as belonging to them. But at long last they have begun to be awake to the plain demands of the situation. Though some states still tolerate the law of capture and some are still dabbling with half-measures, others have acted resolutely and vigorously. In many oil states there is a disposition to leave it to the operators of oil fields as to whether they shall unitize or not, and here is where the futility of half measures shows up in varying degrees. In some cases it is provided by law that an oil field may be unitized if 85 percent of the owners can agree. This means that a rump of 16 percent, who may be actuated by various motives including desire to exploit their nuisance value, or failure to understand how unitization would benefit them along with all the other owners, can veto any plan. In other cases the majority required for unitization is lowered to 75 percent, which means that the dissident rump must be greater than 25 percent. This helps to a degree, but in practice has not proved to be enough. In other states, as in Louisiana, only a simple majority is required for unitization.

The state where legal and administrative support for unitization is on the most comprehensive base is Texas. In Texas voluntary unitization is permissible, but the matter is not left entirely on that basis. Provision is made for cases where owners have not displayed a sufficiency of cooperative spirit or awareness of their public responsibilities as exploiters of a natural resource which is certainly affected with public interest. The Texas Railroad Commission is empowered by state law to take all appropriate measures for preventing waste in the oil fields and to promote the efficient operation of oil wells; efficient operation in this sense means maximum efficient recovery (MER) which will result in extracting the largest possible amount of oil from an underground reservoir. Under this authority the Commission has taken upon itself the responsibility of prohibiting wasteful practices by issuing appropriate orders (after hearings), and recently went to the extreme of prohibiting further operation of the important Seeligson field until its orders were obeyed.

This order of the Commission was attacked in the courts, but the Texas Supreme Court, following the all-but-forgotten principle laid down by the United States Supreme Court in the Ohio Oil Co. vs. Indiana case, upheld its action as a valid exercise of police power in the public interest.

In view of the great public importance of the question of unitizing oil fields, it is a singular fact that so little is known about it. Even the Interstate Oil Compact Commission, which was organized 20 years ago for the express purpose of promoting the conservation of petroleum resources, recently confessed that it did not possess comprehensive information about the numbers or locations of unitized oil fields now existing or where unitized projects, particularly for secondary recovery, might well be initiated. However, the Compact Commission is now making substantial moves in this direction. It has had a committee at work for some time in a survey of the situation, and publication of this report is nearly due.

Until this report is published, the most detailed information on existing unitization projects for pressure maintenance and secondary recovery is contained in an address presented to the May, 1947, meeting of the Mid-Continent Division of Production of the API by K. E. Beall of the Phillips Petroleum Company, under the title, "Unitization in Oil Fields of the United States." In preparing his address, Mr. Beall sent out questionnaires through the various API committees throughout the country. These questionnaires were designed to collect data on important points covering the unitization itself, and were purposely made simple so that it would not be burdensome on the part of anyone filling them out, and no data were requested as to which there should have been any reluctance to give the figures. However, some committees in sections of the country where there are some units in operation did not report. Questionnaires were returned covering 47 unitized operations.

Excepts from Mr. Beall's summaries are quoted below:

The geographical location of the units is in-

teresting in indicating the portions of the country where the unitization principle is most actively working.

Kansas	18
Oklahoma	12
Texas	7*
California	5
Arkansas	1*
Louisiana	2*
New Mexico	1
Illinois	1
Total	47

* Incomplete report

In some pools where secondary recovery is the purpose, partial unitization of royalty is deemed to be almost as satisfactory as complete unitization, provided the royalty units are large enough to permit flexible operations.

The type of operation carried on in the various units is fairly well divided between the two principal types of secondary recovery, gas repressuring and water flooding, and pressure maintenance projects. Of the total units reported, we find the following:

Gas Repressure	19
Water Flood	14
Total Secondary Recovery	33
Pressure Maintenance	14
Total	47

The different bases used in determining the equities or percentages of interest in the cases of unitizations of working interests and royalty interests are shown below. The variety of bases is significant. It proves there is no one way that has to be followed, and certainly no one that can claim to be the only equitable way. Whatever plan can be agreed to by the interested parties is the one to use. In most cases where the royalty is unitized, the basis of unitizing it is not the same as was used for the working interest. It is not necessary that it should be, although in the flush pressure maintenance units, it is better that the same basis be used. Where the royalty is unitized under a state law, it must be on the same basis is is used for the working interest.

Unitization of Working Interests

No.	Basis of Determining Equities
14	Number of wells, current and cumulative production.
10	Consolidation of leases having the same ownership.
6	Productive sand volume.
5	Productive acreage
2	Estimated oil reserves
2	Total acreage
2	Number of wells and current production.
1	Acreage and number of wells.
1	Allowable.
1	Allowable and potential
1	Number of wells, bottom hole pressures, acreage and sand thickness.
1	Cumulative production, number of wells, volume of oil and gas sands and current production.
1	Number of wells, productive acre fee and productive acreage.

Unitization of Royalty Interests

No.	Basis of Determining Equities
12	Interests already under same ownership.
10	Current income.
4	Productive sand volume.
3	Productive acreage
2	Estimated reserves
2	Past production.
1	Number of wells, current production and cumulative production.
1	Allowable.
1	Cumulative production, number of wells, volume of oil and gas sands and current production.
1	Number of wells, bottom hole pressure, acreage and sand thickness.
10	Not unitized.
47	

The reporters made some comments concerning the general benefits or efficiencies growing out of unitized operations. These comments fell generally into the following classifications:

Advantages

(1) Increased flowing life of the wells.
(2) Increased recovery of products.
(3) Retarded decline rate of production, reduced operating costs and permitted shutting in high gas-oil ratio wells.

Disadvantages

(1) Maximum benefits not realized due to lack of control over acreage not unitized.
(2) Operations would have been more efficient had royalty interests been unitized.
(3) Failure to unitize royalty prevented control of gas cap.
(4) Large number of royalty owners presented tedious and expensive task of obtaining signatures to royalty unitization agreement.

It is interesting that in no case has any notation been made of the failure of unitized operations. As a matter of fact the results of unitized operations are almost invariably favorable.

In this connection, it must be remembered, of course, that units are not formed by the interested operators unless there is good reason to believe that conditions in the pool and the reservoir from which production is to be obtained are favorable for successful operations of the type intended. The industry now has sufficient data as to performance of various types of reservoirs under gas repressure and water flood operations so that increased production, investment costs, operating costs and profits can be predicted with a fair degree of accuracy. There should be no reason why units formed for secondary recovery operation after a careful analysis of all the pertinent facts should not not be successful.

From the foregoing, it is evident that much progress has been made in the matter of forming units to take advantage of the many benefits incident thereto. If data had been submitted on every unit operation, the number would have been considerably larger. The units already formed are able to stand on their own feet and account for themselves to the satisfaction of all the interested parties, but what of the future? Will there continue to be units formed? The answer to this question is undoubtedly that more and more units will be formed as time progresses and the tremendous advantages of this type of operation and more important pools and will be formed in which will be formed will involve much larger and more important pools an dwill be formed in time for a much greater proportion of the productive life of the pool to be affected by the unitization. The smaller units, primarily for the purpose of taking advantage of secondary recovery operations in partially or almost completely depleted pools, will continue to be formed and render good account of themselves, but the most important uses of unitization in the future will be in its connection with pressure maintenance and recycling operations where it is so essential and where the benefits are of such magnitude as to demand attention of the entire industry.

Pantepec Divides Holdings

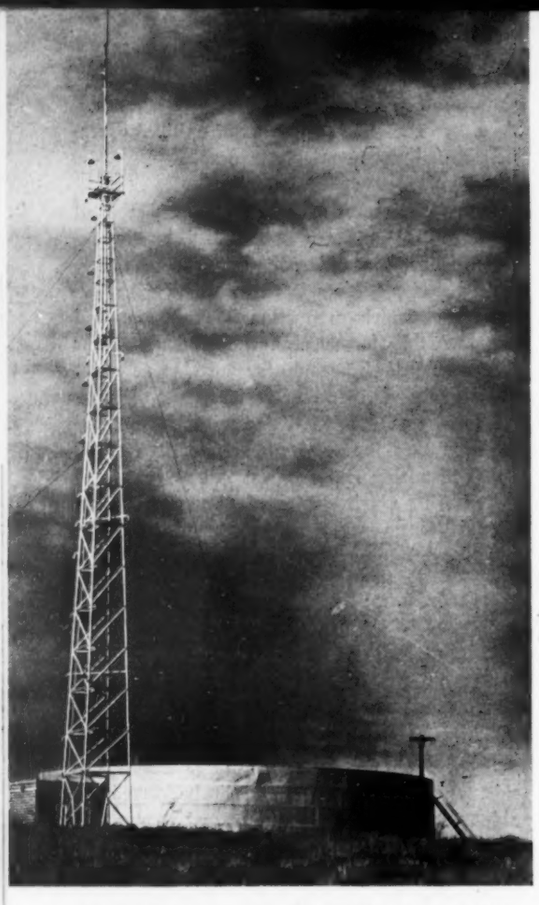
Stockholders of Pantepec Oil Company of Venezuela have approved a plan of reorganization under which it will be succeeded by two corporations. One of these will be Pantepec Oil Company C.A., incorporated in Venezuela with 3,000,000 shares of common stock of a par value of one bolivar each. It will take over the producing properties of the original company including 28,330 hectares operated jointly with Creole Petroleum Corporation. It also will assume the contract entered into last year with Compagnie Francaise des Petroles providing for purchase by it of Pantepec's share in this production.

The second company will be known as Pancoastal Oil C.A. It will issue 6,000,000 shares with a par value of one bolivar each and will retain in its treasury an additional 2,000,000 shares which may be issued later. It will hold 132,000 hectares in Venezuela which are being developed jointly with Atlantic Refining Company and approximately 2,000,000 hectares of coastal lands and waterways in and adjoining the state of Florida, U. S. A. Stockholders of the present company will receive one share of Pantepec Oil Company C.A. and two shares of Pancoastal Oil Company C.A. for each share of their holdings. Officers and directors of Pantepec C.A. will remain unchanged. Officers of Pancoastal will be C. U. Daniels, president; J. E. Fitz-Patrick and John W. Buckley, vice presidents; Roberto Pardo B., secretary and treasurer. Object of the partitioning, as explained by President Daniels, is to separate the settled producing properties of the company from its undeveloped holdings. Exploration and development of these will require large investment and will involve the usual hazards of wildcatting with uncertainty as to ultimate return. Under the plan adopted, shareholders who do not care to participate in these risks will be able to dispose of their Pancoastal shares and still retain their interest in the producing company.

Stanolind Names Geologist

R. W. Craig has been appointed senior geologist for Stanolind Oil & Gas Co. at its recently opened Canadian producing headquarters at Calgary, Alberta. Mr. Craig formerly was geologist at Lake Charles, La. Other additions to Stanolind's Canadian division are: W. B. Longshore, senior landman; T. B. Hewitt, landman; and J. H. Helland, geologist scout.

FM RADIO SPEEDS HUBER CORP. FIELD OPERATIONS IN TEXAS



Mast and transmitter house for KGTG, the J. M. Huber Corporation's FM radio system at Borger, Texas.

THE recent installation of a two-way radio system at Borger, Texas, by the J. M. Huber Corp. has enabled the company to effect savings of time, money and trouble. Radio communication has proved invaluable to the drilling production, gas and electrical departments of this organization.

Drilling rigs require numerous parts and pieces of equipment to keep them running, and progress information must be relayed to the office at frequent intervals. Transmitting these supplies and information meant many long trips, tough in good weather and almost impossible in bad. Now, by radio-telephone communication, one trip with supplies usually suffices where several were necessary. Information can be had by merely "calling up" the rig and asking for it.

An actual case example of time and effort saved by Huber's production department is illustrated by this normal incident. A small pump located several miles north of Borger was needed the following day on a lease south of town. The superintendent in the field radioed the truck foreman, also out on the job. Knowing that two trucks were at a drilling rig in the vicinity of the pump, the latter radioed the rig and instructed the drivers to stop by and pick up the pump on their way back.

The FM radio system consists of a main transmitter with a power of 250 watts and 24 mobile and portable units; 20 of which have a power of 50 watts and four have an output of 25 watts. The main transmitter sends and receives for the central monitoring set and for three remote control stations.

The main transmitter is located on one of the highest hills in the Borger area, and this basic elevation plus the 148-foot aerial gives the main station enough height to blanket the 1170-square mile area in which the vehicles and drilling rigs normally operate. The transmitter itself is located in a brick building at the foot of a converted drilling mast, which supports the antenna. In this building is an emergency power generator, run by gasoline, which automatically starts in the event of a power failure.

The monitoring set is located in a warehouse where it is in operation 24 hours a day. This station keeps a log of all messages that are sent by all units and acts as a relay station for the three remote control sets.

At the present time 17 mobile units are installed in various cars and trucks, and seven portable units are at drilling rigs, a camp and a booster station. The main transmitter has the call letters KGTG, while the mobile and portable sets have the call letters KGTV followed by the number of the car or portable unit. Huber superintendents estimate that within the next few years they will be operating approximately 50 mobile and portable units. Seventy-six new oil and gas wells were drilled during 1947, and the J. M. Huber Corp. now has over three hundred producing wells in Texas and Kansas.

The Huber gas department headquarters keeps in constant contact with the situation in the field through its fleet of eight radio-equipped cars plus a radio connection with its faraway Bryan-Mayfield gas booster station.

The radio system is of value to the company's electrical department in its repair and maintenance work, especially in bad weather when repair calls are most frequent. The Huber electrical department is responsible for the operation of 1,050 electric motors on the company properties. It maintains 150 miles of high line and 175 transformers. The company pumps 140 wells with electric motors and pumps 20 million gallons of water through 30 miles of water lines each month. The electrical department maintains 30 miles of company telephone line as well as the radio system.

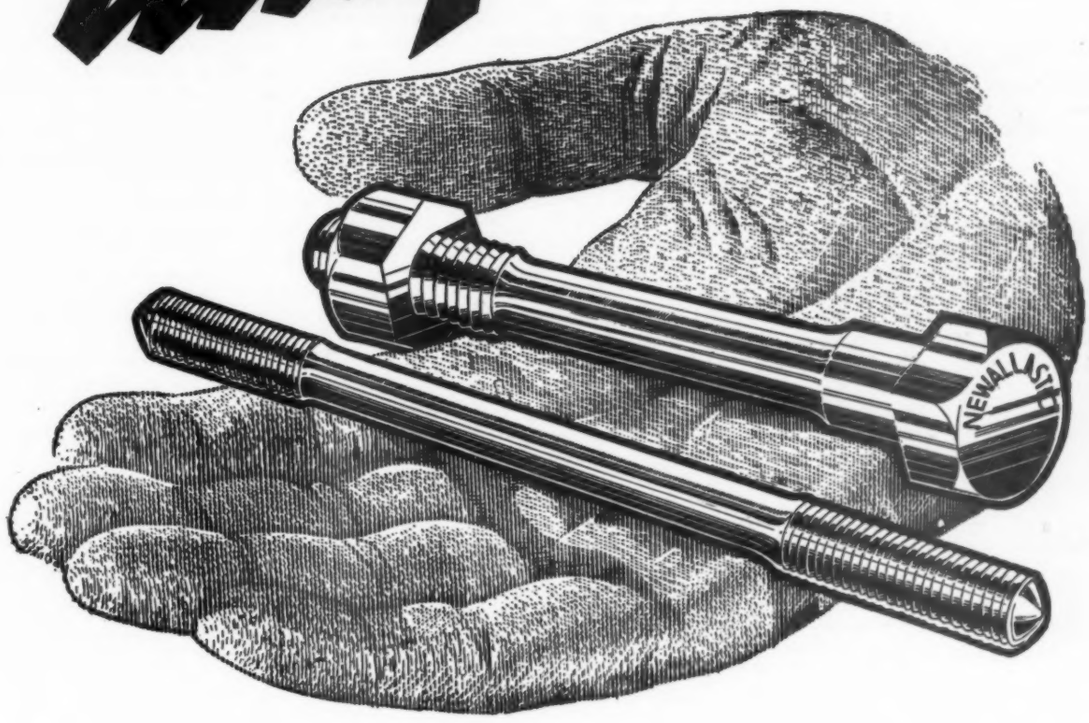
The Huber Corp. also produces natural gasoline and operates the world's largest single channel carbon black manufacturing unit in Borger, Texas. The company-owned natural gas wells furnish the basic raw material for carbon black.

Other phases of the corporation's operations include the mining and processing of clay for rubber and paper manufacture, rubber compounding chemicals and printing inks.

Sending a message from the central monitoring set. This is a relay system for three remote control sets.

Receiving a message on one of the mobile units in the field.

Unique



"Newallastic" bolts and studs have qualities which are absolutely unique. They have been tested by every known device, and have been proved to be stronger and more resistant to fatigue than bolts or studs made by the usual method.

C. P. Newall & Co., Ltd.

POSSILPARK GLASGOW · N

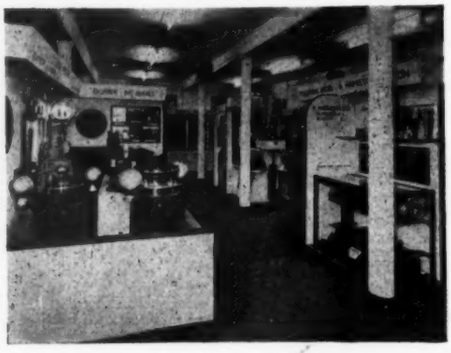
International News and Notes

Anglo Absorbs AGWI

Agwi Petroleum Corp., Ltd., has been absorbed by Anglo-American Oil Co., Ltd., and his become the refining department of the latter company.

Agwi was originally organized in 1920 by Atlantic Gulf and West Indies Steamship Co. It was taken over by 1934 by British Mexican Petroleum Corp. and two years later was purchased by Standard Oil Co. (N. J.) which modernized and enlarged the plant by adding cracking stills, asphalt plant and many other facilities. During the war the plant was a link in the "Pluto" pipeline system to Normandy.

A very large expansion program is planned for the Fawley plant as soon as supply conditions permit. The present capacity of 14,000 barrels daily is expected to be enlarged to 120,000 barrels daily. Currently the plant is processing both Middle Eastern and Latin American crudes.



Permanent Engineering Center

British manufacturers of industrial equipment recently opened The Engineering Center at Glasgow in which a large variety of materials and equipment used by various industries will be on permanent display. Some 100,000 square feet of exhibit space is available at the center on Sauchiehall Street, Glasgow. A staff is available to answer questions of visitors who may desire information without first committing themselves to the individual manufacturers. A great many foreign visitors from all part of the world have viewed the exhibits since they formerly were opened on Dec. 3, 1947.

YPFB Plans Expansion

As a result of studies made by Bolivian technologists working in collaboration with foreign technologists and company specialists from the United States, an early objective in the program of the Yacimientos Petroleras Fiscales Bolivanos is completion of the refinery at Cochabamba. This undertaking has been selected because it represents the most strategic point from which to distribute refined petroleum products to the principal consuming centers in the departments of La Paz, Oruro, Cochabamba, part of Santa Cruz and the City of Potosi. Engineering and economic calculations have shown the advantage of a single efficient refinery at Cochabamba over the previous plans of building a refinery at Cochabamba and a smaller one of a different type at Sucre. The revised plan is the one most favored by the Banco de Exportaciones.

Next in importance is a project to develop the oil deposits of Bermejo and the eventual construction of a pipeline to Nazareno and the installation of a refinery at the latter point. This will make fuel oil more accessible and increase the supply of lubricants and greases for industrial use. Another interesting point on the program is the development of oil deposits to the north of La Paz and Beni, with a pipeline supplying a refinery near La Paz.

This program may be considered as having been begun, but its progress has encountered numerous obstacles, principally the difficulty of obtaining material from the United States.

Oil Men In U. S. Foreign Service

Stirred apparently by the charge that the foreign staff of the United States State Department is largely composed of men without business or professional experience, the Office of Foreign Service has compiled a statement showing that 71 percent of its 2,638 officers held commercial jobs or were engaged in professional work prior to their employment by the government.

Five men drawn from the oil industry, it is pointed out, are serving as special petroleum attaches. Their duties are to supply information regarding developments in the oil industry in the areas where they are located and to make recommendations on requests for critical materials for use in those areas. These specialists are Ivan G. Harmon, formerly with Marland Oil Company, later with PAW and now stationed at Rio de Janeiro; Albert Lager, who spent 17 years with Siosi Oil Company before joining the foreign service and who is now at Bogota, Colombia. George Levangle who was for over 20 years engaged in geological and production work for Standard Oil of Argentine, now stationed at Lima, Peru; Richard Funkhouser, a former Shell employee, now a secretary and attache in Cairo, Egypt; Olaf F. Sundt who began his oil experience in Texas, later served in Europe and South America, was appointed to the Foreign Service office in 1944 and recently was assigned to the Paris Embassy.

Aside from these petroleum attaches a number of men with oil industry backgrounds are now connected with the Office of Foreign Service. Among them are Scott C. Lyon of the technical service division; Robert S. Henderson, who was in the economics division of Standard Oil Co. (N. J.) before his appointment as vice consul at Naples; Howard B. Brandon, formerly an independent marketer in Georgia, now vice consul at Algiers; Randolph Cahn who work for The Texas Company in Brazil and is now vice consul at Rio de Janeiro; and Marshall M. Vance, a former employee of Standard Oil Co. in Java, now serving as consul in Berlin.

Venezuelan Production

Production of crude petroleum in Venezuela during the month of January amounted to 39,726,830 barrels. Exportation for the month was 35,006,875 barrels. Production by companies was as follows:

	West	East	Total
Creole	14,585,417	4,711,220	19,296,637
Mene Grande	1,948,479	4,832,526	6,781,005
Shell	11,666,414	—	11,666,414
Consolidada	—	606,680	606,680
Socony	—	895,197	895,197
Texas	189,387	185,813	375,200
S.A.P. Las Mercedes	—	1,262	1,262
B.C.O.	34,859	—	34,859
Orinoco	10,202	—	10,202
Phillips	—	57,586	57,586
Varco	—	1,788	1,788
Total barrels	28,434,758	11,292,072	39,726,830

Vigzol Elects Directors

S. Elliman, W. L. Hill and R. E. Rhodes have been elected to the board of The Vigzol Oil Co., Ltd., London. J. L. Balmforth has resigned from the board because of ill health. The company recently changed its name from The Vigzol Oil Refining Co., Ltd., by dropping the word "Refining."

Production Rate In Alberta

Conditions affecting production in the newly-developed Leduc field in Alberta, Canada, have caused the Petroleum and Natural Gas Conservation Board of Alberta to revise its regulation limiting well output to 100 barrels daily, Under a decision effective from February 13, wells producing from the D-3 zone are allowed 150 barrels daily, while those producing from the D-2 are still limited to 100 barrels. This rule is to apply for a period of 69 days to permit an appraisal of the maximum efficient rate of production and the proper gas-oil ratio for each well.

Turkish Well Successful

Maden Tetkik ve Arama Enstitusu, Turkish government oil company, has completed a well on the Ramandag structure in the southeastern part of the country according to cable advices from Turkey. The well is said to be swabbing 300 to 400 barrels daily of 15 gravity asphaltic base oil. The well was completed at a depth of 4,078 feet by Drilling and Exploration Co., Inc., which is in charge of drilling operations. Mr. Ishan Ruhi Berent is director of the Turkish government company.

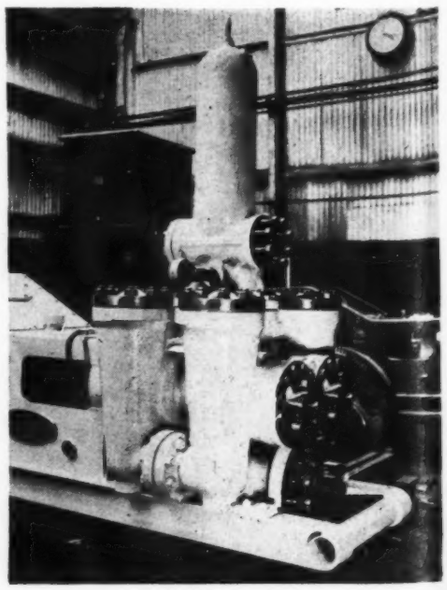
Mechanical Handling Exhibition

The appointment is announced of Rooster Publicity, Ltd., of Peterborough and London, as press photographers at the Mechanical Handling Exhibition to be held at Olympia in July, 1948. Rooster Publicity will also be responsible for photography of stands and exhibits. The photography will be directed by C. B. A'Court, who is well known for his specialized treatment of mechanical handling subjects.

British Slush Pump

A new slush pump of all-British manufacture has been announced by British Oilfield Equipment Co. Ltd., of Hunslet, Leeds. The pump is built of alloy steel with special attention to weight factors for economical transportation to and in the fields. Net weight is 11,870 pounds and export shipping weight 14,500 pounds. The power end is completely enclosed, but large inspection plates are provided to give access to internal gears, crosshead, connecting rods, etc.

Pump capacity with 7¼-inch liner is 400 Imp. GPM at 65 RPM, and various size liners are available down to five-inch with a capacity of 150 Imp.GPM. Working pressure of the pump is 2,000 psi and test pressure 3,500 psi.



Why Chemico-built Plants are Profitable

Improved Processes

A chemical plant is only as good as the process it uses. Chemico originates, controls, and provides many of the most advanced processes and equipment . . . develops entirely new processes where necessary.

Individually Designed

Chemico-built plants are designed to meet each client's requirements. Capacity, type of raw material, available utilities, location, space limitations . . . all are considered.

Economical Use of Manpower

Automatic operation, centralized control, efficient plant layout . . . reduce manpower requirements and make more productive use of every man-hour.

Minimum Maintenance

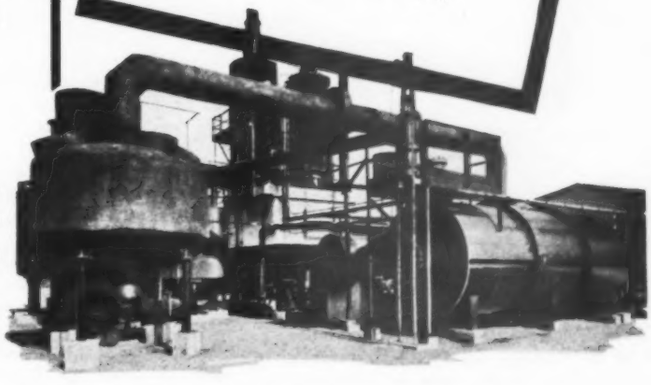
Maintenance problems are simplified through the use of carefully selected equipment and improved processes, and careful layout of the plant. Repairs are never "hard to get at."

Experience

Chemico designs and builds many kinds of heavy-chemical plants . . . has been doing this for 34 years. Over 600 installations the world over are evidence of Chemico's successful experience.

Chemico furnishes these plants under one contract—one responsibility—with an iron-clad performance guarantee . . . is prepared to undertake other similar projects on the same basis.

N. E. C. SYNTHETIC AMMONIA
N. E. C. SYNTHETIC METHANOL
NITRIC ACID
PHOSPHORIC ACID
COMPLETE FERTILIZER PLANTS
SULFURIC ACID
PRODUCTION, CONCENTRATION, RECOVERY
PETROLEUM SLUDGE CONVERSION
FORMALIN
WILTON PROCESS TAR DISTILLATION



CHEMICO
CHEMICAL CONSTRUCTION CORP.

CHEMICAL CONSTRUCTION CORPORATION

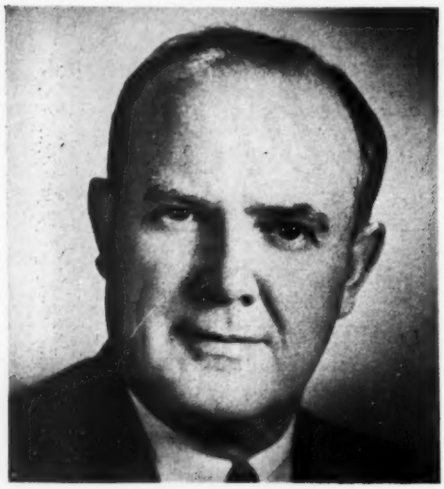
EMPIRE STATE BLDG., 350 FIFTH AVENUE, NEW YORK 1, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE
CYANAMID PRODUCTS, LTD., BRETTENHAM HOUSE, LANCASTER PLACE, LONDON W. C. 2, ENGLAND
EUROPEAN LICENSEE OF N. E. C. PROCESS
HYDRO-NITRO S. A., 8 QUAI DO CHEVAL BLANC, GENEVA, SWITZERLAND
CABLES: CHEMICONST, NEW YORK

"Chemical plants are profitable investments"

CC 165

OIL COMPANY STAFF CHANGES



Floyd L. Martin

Howard H. Hinson

FLOYD L. MARTIN has been elected executive vice president of Sunray Oil Corp. but will continue to direct the company's refining and sales division. Mr. Martin came to Oklahoma from West Virginia with the oil boom of 1916. Having served a refining apprenticeship in Oklahoma at Jennings, Allen, Sand Springs, Tulsa and Ponca City, he joined Sunray in 1930 to operate the company's Allen, Okla., refinery acquired from the former Homaokla Oil Co. He was elected a vice president in 1935 and a director in 1941.

E. E. SOUBRY, manager of the marketing coordination department of Standard Oil Co. (N. J.), has announced several staff assignments as follows: W. R. Goodwin as deputy coordinator and G. H. Michler as executive assistant; J. W. Connolly as assistant coordinator for domestic marketing activities and P. T. Lamont to have similar responsibilities for foreign marketing. Domestic advisors associated with Mr. Connolly are J. A. Miller and F. W. Butler. Foreign marketing advisors with Mr. Lamont are C. T. Helm for Latin America, with D. W. Ramsey as deputy and R. H. Collette and D. N. Cameron as assistants. F. H. Billups becomes marketing advisor for Europe, with G. M. Parker as deputy and W. R. Maddux and D. H. West as assistants. J. R. Riddell becomes advisor on costs and operations, and W. E. Haley will be general secretary to the coordination group.

WARREN LOWE BAKER of New York, manager of the aviation department of the Socony-Vacuum Oil Co., is the new chairman of the aviation advisory committee of the American petroleum industries committee of the American Petroleum Institute. He succeeds Aubrey Keif of The Texas Co. Middleton DeCamp, of Louisville, Ky., who heads the aviation department of the Standard Oil Co. of Kentucky, is the new vice chairman of the committee, succeeding L. A. Henry of the Standard Oil Co. of Indiana.

WILLIAM C. TAYLOR has been appointed director of the foreign department of Sun Oil Co. He has been acting director of the department since the death of John A. Lloyd last June, is now on his way to Europe to visit a number of Sun's foreign offices. Mr. Taylor joined Sun's development division at the Marcus Hook refinery in 1933, immediately after graduation from the University of Pennsylvania. In 1937 he was transferred to the industrial products department, and in January, 1946, was named assistant manager of the foreign department.

HOWARD H. HINSON of Amarillo, Texas, has been appointed chief engineer of Continental Oil Company's production research section. Mr. Hinson was formerly assistant supervising engineer of the U. S. Bureau of Mines' helium plants at Amarillo and had charge of all government-owned gas fields and pipelines supplying gas to helium plants.

Born in Fletcher, Okla., he attended elementry schools in Oklahoma and New Mexico and was graduated from high school in Lubbock, Texas. He was graduated from Texas Technological College in 1934 with a degree of geological engineering and later received his master's degree in geology. He is a member of the American Institute of Mining and Metallurgical Engineers and the American Association of Petroleum Geologists.

DR. H. G. BURKS, JR., director, has been appointed general manager of manufacturing operations of Esso Standard Oil Company. At the same time H. W. Fisher, also a director, was named to succeed Dr. Burks as general manager of East Coast refineries. Both men, whose entire business careers have been with the company, joined Esso on graduation from the Massachusetts Institute of Technology more than 20 years ago.

Dr. Burks started as a development engineer at the Bayway refinery in Linden, New Jersey. He was appointed manager of East Coast refineries in 1946. Mr. Fisher joined the company as a chemical engineer at the Baton Rouge, Louisiana, refinery and much of his career has been devoted to the development and production of chemicals from petroleum. He is president of Enjay Company, Inc., a subsidiary of Standard Oil Company (N.J.) devoted to marketing of petroleum chemicals in the United States.

DANA S. MELLETT, chief engineer of the Trenton, Mich., refinery of the Socony-Vacuum Oil Co., Inc., has been appointed vice president of the Mediterranean Refining Co. E. A. Wilson has been appointed chief engineer to succeed Mr. Mellett.

ALBERT E. SWEENEY, JR., former field engineer for the Fairbanks Operators committee, has assumed his duties as director of the secondary recovery division of the Interstate Oil Compact Commission. Initial work of the new Compact division is accumulation of statistical information relating to secondary recovery operations in the various states, and the first state being surveyed is Kansas. The secondary recovery advisory committee, having general supervision of the work, consists of twelve members from various sections of the United States with Paul Torrey, Houston, Texas, consulting engineer, as chairman, and J. P. Jones of the Pennsylvania Grade Crude Oil Association, Bradford, Pa., as vice chairman.

G. T. BUSKIRK will be division geologist and in charge of Stanolind oil and Gas Company's exploration office in Bogota, Colombia, C. T. Jones, manager of foreign exploration, has announced. Buskirk will have a six-man staff of Stanolind men transferred from the United States and will hire additional employees in Bogota.

Mr. Buskirk, formerly district geologist at San Antonio, Texas, will have the following people working with him: J. A. Thompson, office manager; J. H. Chivers, geologist; J. W. Vanderbeek, geologist; W. A. Sidwell, landman; Jack Hunter, geologist scout; Frank Crespo, clerk.

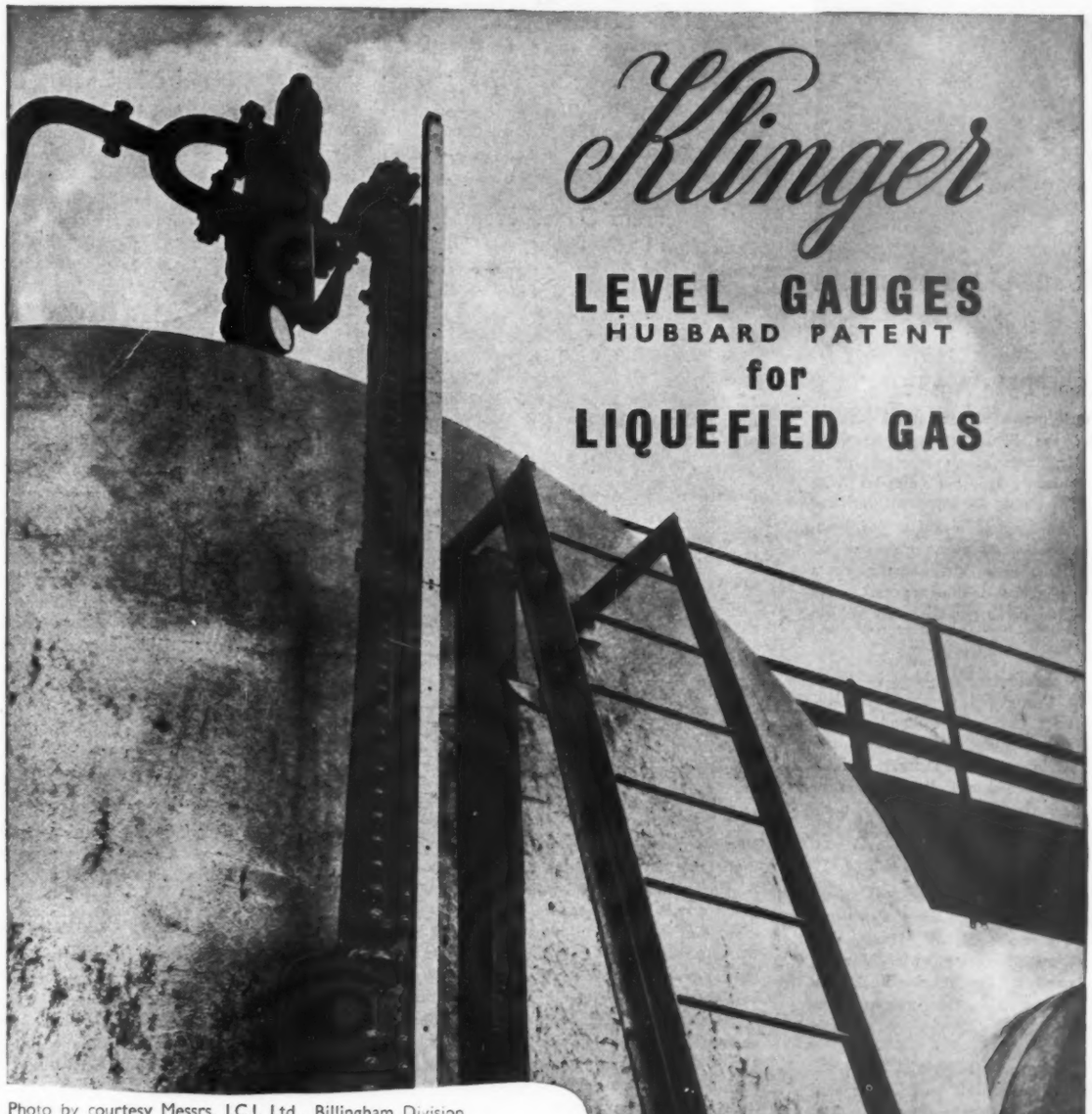
ROBERT DUNN, assistant general sales manager of the lubricants division of the Macmillan Petroleum Corp., has been appointed sales manager of the eastern division. He will have charge of sales and service in nineteen eastern and southern states and will continue to maintain his headquarters in the RCA Building, New York. Lyle Davis, Chicago branch manager, was made midwest division sales manager in charge of sales and service for nineteen states.

FRANK ANDREWS has been appointed sales manager for the Sid Richardson Carbon Co., the new organization that will operate the Odessa, Texas, carbon black plant recently purchased from the War Assets Administration. The Odessa plant now has an annual capacity of about 53 million pounds. This is being increased to approximately 71 million pounds by the addition of a third unit. Most of the material is now on the site. When completed this plant will be one of the largest channel black plants in the world.

The Sid Richardson Gasoline Co. also is building a natural gasoline plant in the Keystone field near Kermit, Texas. When completed this plant will have a daily production to about 86 thousand gallons of propane and butane and 120 thousand gallons of natural gasoline. The latter will eventually be separated into a wide range of close-cut solvents.

Frank Andrews is well known in the liquefied gas, solvents, rubber and carbon black industries. His original experience with Phillips, starting in 1929, was in the liquefied gas field. In 1940 he organized the sales department for Hycar Chemical Co.; in 1943 he started the marketing division for Phillips furnace black and later was manager of the chemical products department.

Frank Andrews



Klinger

LEVEL GAUGES
HUBBARD PATENT
for
LIQUEFIED GAS

Photo by courtesy Messrs. I.C.I. Ltd., Billingham Division

DIFFICULTY is often experienced in reading the level of liquefied gas, such as butane or propane, owing to boiling and ebullition of the liquid in the gauge. This is prevented by the Hubbard patent applied to the Klinger reflex gauge, by means of which a small amount of gas is expanded into a special chamber in the back of the gauge, thus cooling the whole of the gauge and its contents.

Klinger Hubbard Patent gauges can be made to any length corresponding to the sizes of the Klinger standard "K" type Reflex gauge.

Full details are obtainable from :

RICHARD KLINGER LIMITED

KLINGERIT WORKS · SIDCUP · KENT · ENGLAND

E. H. Short, Jr.

Short Joins Dyke Agency

Ed H. Short, Jr., well-known writer on oil industry subjects, has joined the Frank Dyke Advertising Agency, Houston. Mr. Short has been in charge of the Oil and Gas Journal's Houston editorial office since 1943. Prior to that time he was with the Gulf Oil Corporation in Tulsa for a period of 17 years, engaged in engineering work and as an executive assistant. During the past year Mr. Short made a series of studies of offshore drilling operations in the Gulf of Mexico, and his articles on this subject attracted wide interest.

R. B. CURRAN was elected vice president in charge of production of The Carter Oil Company effective March 1. He has been a vice president and director of Carter as well as manager of the company's northwest division, with headquarters in Denver. In his new assignment he has returned to Tulsa to direct the company's production activities. The position formerly was held by J. R. McWilliams who recently was named executive vice president.

C. E. WHARTON has been appointed general superintendent of gasoline plants for Warren Petroleum Corp., Tulsa. He will assist H. W. Harts, vice president in charge of manufacturing. Mr. Wharton was general superintendent for Hanlon-Buchanan, Inc., at Gladewater, Texas, when that company was purchased by Warren.

R. J. S. PIGOTT is the first oil man to head the Society of Automotive Engineers. He was inaugurated president at the annual meeting in January. Mr. Piggott has been chief of the engineering division of Gulf Research & Development Co. since 1929. Columbia University awarded him a medal for engineering achievement in 1946.

Appointed Technical Adviser

A. C. Thompson, who has been appointed technical adviser to Esso Transportation Co., Ltd., recently was awarded the Medal of Freedom from the U. S. Navy for his war services. He headed a group of tanker experts in the United Kingdom during the war.

Gen. Hauseman Heads Houdry

Brig. General David N. Hauseman, U. S. Army retired, has been elected president of Houdry Process Corp., to succeed Eugene J. Houdry, founder of the company who is retiring from the company. General Hauseman also will be chairman of the Catalytic Construction, Houdry subsidiary.

Under a new policy directors of Houdry Process Corp. will be exclusively men working in the corporation. The newly-elected directors are: General Hauseman; Arthur V. Danner, executive vice president; Claude C. Peavy, chief engineer; John E. Ford, manager of commercial development; Gordon A. Kessler, manager of patent department; C. G. Kirkbride, manager of laboratories; T. Ellwood Webster, president of Catalytic Construction Co.; George H. Daft, comptroller; John D. M. Hamilton, secretary and general counsel.

General Hauseman has resigned as vice president of Temple University, Philadelphia, and president of the Research Institute of Temple University to join the Houdry companies. He retired from the army in 1946 after 29 years of service. He served in both world wars and rose from private to Brigadier General. In recognition of his service he was awarded the Legion of Merit and the Distinguished Service Medal and both the Army and the Navy Commendation Awards.

Frank O'Neill Promoted

Frank E. O'Neill, veteran oil man, has been promoted from chief engineer to assistant to the president of the M. O. Johnston Oil Field Service Corp. Mr. O'Neill has been active in the oil business in California since 1920. Starting with the oil department of Southern Pacific Railroad, he served Pacific Oil Co., Standard Oil Co. and Superior Oil Co. He was with M. O. Johnston from 1933 to 1938 and rejoined the company two years ago.

Arch Rater Moves To Oil Base

Arch Rater, Jr., has been appointed service engineer for Oil Base, Inc., Compton, Calif. He will be Oil Base representative in the Mid-Continent with Oklahoma City headquarters after spending some time in the California area.

Kobe Promotes J. C. Cooper

J. C. Cooper was recently promoted to district manager for Kobe, Inc., in the Rocky Mountain district where he has acted as district representative. He joined Kobe in September, 1945, as a junior engineer in California and was transferred to the Rocky Mountain district in July, 1946.

New D/B Chief Engineer

Dan Duncan, executive engineer of Emsco Derrick & Equipment Co., announces the appointment of David A. Carnahan as chief engineer of the D/B division. Mr. Carnahan was born on the Shell lease at McKittrick, California. He attended Stanford University where he graduated with an engineering degree. Following graduation, he worked in practically every field in California. Prior to the war he was affiliated with D/B in the engineering department. During the war he was a lieutenant in the Navy. As chief engineer, Mr. Carnaham will supervise the development and engineering of subsurface equipment at both the Dallas and Los Angeles plants.

Dan Duncan

David A. Carnahan

Wheatley Appointment

Frank Wheatley, Jr., was elected executive vice president at the recent annual meeting of Wheatley Pump and Valve Manufacturers. Gus Baker, Jr., was made vice president and general manager, and William J. Gray was elected vice president in charge of manufacturing. Dan L. Lingo was elected secretary-treasurer to succeed Miss Dorothy Page who retired after 20 years' service. Earl Wagner also retired as shop superintendent after 30 years with the company.

Head Allis-Chalmers Turbine Dept.

E. H. Hortsman and Hans P. Dahlstrand have been named respectively chief engineer and director of engineering of the Allis-Chalmers steam turbine department, according to an announcement by William A. Yost, Jr., department manager. Mr. Horstman, formerly assistant chief engineer of the Allis-Chalmers steam turbine department, has been with the company since 1923. While on leave of absence during part of 1945 and 1946, he served as a scientific consultant for the United States government as an investigator of power plant equipment in Germany. Mr. Dahlstrand has been associated with Allis-Chalmers since 1904 and has held the position of engineer-in-charge, chief engineer, and more recently consulting engineer of the company's steam turbine department.

Povl Ostergaard

Povl Ostergaard, chief process engineer of Gulf Oil Corp., died February 17, 1948, at the Montefiore Hospital, Pittsburgh, after a brief illness. Born in Horsens, Denmark, April 5, 1899, Mr. Ostergaard came to Pittsburgh to work for Westinghouse in 1925 and joined Gulf at Port Arthur, Texas, in 1926. At Port Arthur he worked on the development of high-pressure hot oil pumps, heat exchangers and other adjuncts of the thermal cracking processes of that period. Mr. Ostergaard is principally known for his work in connection with the Gulf Polyform process which he invented and developed.

Appoints Export Representative

Bethlehem Supply Co. has appointed the Petroleum Machinery Corp., 30 Rockefeller Plaza, New York 20, as exclusive export agents for Bethlehem rotary machinery, hoists and pumping units.

Buys Prunty Production

A. W. Ambrose, of Bartlesville, president of Cities Service Oil Co., has announced that his company has purchased the capital stock of Prunty Production Co., of Ponca City, Okla. The transaction will give Cities Service ownership of oil producing properties located in the Goodrich, Valley Center, Graber and Skinner fields in Kansas, and in the Deer Creek, Hubbard and Thomas fields in Oklahoma.

This illustration from the W. P. Butterfield series of Yorkshire Dales Scenes shows the ancient Cave Chapel of St. Robert at Knaresborough in Nidderdale

Time has eroded the rock-hewn figure by the door into a curiously modern symbolism, the hand which mayhap once reached for the sword hilt now appears to be feeling for loose coins

THE W. P. BUTTERFIELD Organization gives you greetings, with good wishes for your prosperity throughout 1948

We shall put the best of British craftsmanship into all your work that comes our way

Head Office and Works Shipley, Yorks., England *Phone Shipley 52244*
London, Africa House, Kingsway, W.C. 2 *Phone HOLborn 1449*

BUTTERFIELD *Road Tanks*

FABRICATED IN MILD STEEL, STAINLESS STEEL AND ALUMINIUM

Petroleo Purchased

The Spanish-language magazine, Petroleo, which has been published in Los Angeles for the past twelve years, has been purchased by Mrs. Russell Palmer and Rex W. Wadman. Effective with the April issue, Petroleo will be merged with Petroleo del Mundo and from that date will be produced, printed and mailed from Los Angeles, with executive offices at 412 West Sixth Street, Los Angeles 14.

The staff of the combined magazine will be E. W. Mayo, Sr., editor; J. C. Chatfield, managing editor; Antonio Mendez, associate editor; W. S. Johnson, advertising manager. Editorial features of both Petroleo and Petroleo del Mundo will be continued in the merged magazine, and, of course, the circulation of both books will be covered after duplication has been eliminated.

GEORGE L. LOCKETT has been appointed chief geologist for Mene Grande Oil Co. in Venezuela, to succeed P. O. Nolan who retired after 25 years of service. Harold J. Funkhouser has been made assistant chief geologist to fill Mr. Lockett's old position.

Mr. Lockett has been with Mene Grande for 13 years, starting as a subsurface geologist in the Maracaibo district. He has served in both eastern and western divisions. Mr. Funkhouser started with the company at San Tome nine years ago and was transferred to Caracas in 1946.

Sun Enters Rockies

Sun Oil Company is undertaking a search for oil in the Rocky Mountain Area, Jno. G. Pew, vice president in charge of production, announced. Exploration will be carried on in Wyoming, Utah, Colorado and northern New Mexico. Land and geological offices have been established in Denver, Col., under the direction of Simeon B. Christy and L. W. Storm, respectively, both of whom were formerly attached to the production department at Dallas, Texas.

Italians Want Larger Refining Industry

Italy's requirements of petroleum products during the period of 1945-51 have been estimated in the Marshall Plan as averaging 5,444,100 tons, distributed as follows: 565,000 tons of gasoline, 200,000 tons of kerosene, 660,000 tons of gas-oil, 3,633,000 tons of fuel oil and 379,000 tons of various products including petroleum coke and lubricants. These quantities may have to be reduced owing to action by the United States curtailing the proposals of the Paris Conference, but accepting these figures, the quantity of crude oil to be imported is indicated by the following table:

	Consumption Estimated in Marshall Plan (Tons)	Percentage Obtainable from Crude	Quantity of Crude to Be Used, Metric Tons
Aviation gasoline	53,000	10	530,000
Automobile gasoline	565,000	25	2,260,000
White spirit	17,600	6	293,333
Kerosene	200,000	8	2,500,000
Gas oil	666,600	19	3,508,421
Fuel oil	3,633,600	60	6,056,000
Lubricants	139,000	19	731,578
Bitumen	113,000	15	753,333
Petroleum coke	28,300	15	188,666
Paraffin	28,000	5	560,000

The throughput capacity of the 14 Italian refineries, after repair of war damage, is about 2,200,000 tons which could be increased in 5,000,000 tons by projected construction. The present crude charging capacity of the principal Italian refineries was recently stated as follows: Leghorn, 1,500,000 tons; Bari, 500,000 tons; Porto Marghera (Venice), 1,000,000 tons; La Spezia (Carrara), 1,000,000 tons; Trieste, 500,000 tons, and Naples, 500,000 tons. These refineries after enlargements should give refined products of 4,250,000 tons. Based on the Paris estimate, that would leave a deficit of 1,194,100 tons. In the opinion of Italian business interests, that would justify the construction of new refineries. As a matter of fact the Italian Ministry for Industry and Commerce has received applications for the erection of eight new refining plants with a total output of 2,107,000 tons, which might be increased to a maximum of 3,120,000 tons distributed as follows: 1,500,000 tons at Milan; 1,000,000 tons at Vercelli; 200,000 tons at Mantova; 150,000 tons at Falconara; 25,000 tons in a locality to be decided; 20,000 tons at Florence, and 12,000 tons at Naples.

With the addition to these plants Italy would have an oil-refining industry having a crude oil charging capacity of 8,107,000 tons, which would permit the production of 6,850,000 tons of refined items, or about 1,405,900 tons over the estimate made in the Marshall Plan .

On January 31, 1948, the committee charged with the examination of applications for construction of new industrial plants in Italy took under consideration the proposals for the above-mentioned eight refineries, but no decision has been taken as yet, though it appears that the members of the committee favor the larger plants over the smaller ones.

Advocates of the establishment of refining facilities in Italy beyond the domestic requirements of the country argue in its favor the location of the Italian peninsula midway between the great producing fields of the Middle East and the markets of continental Europe. Refineries located there would be less exposed to destructive attacks, they hold, and Italian shipowners could operate tankers at relatively low costs. Recently the S. A. Gestione Esercizio Navi (GEN) was founded at Genoa for the purpose of operating foreign tankers with Italian crews.

RUST
Red Lead and Graphite finely ground in an oil varnish medium is "R.L.G" — the perfect rust inhibitor.
INTERNATIONAL
R.L.G.
PRIMER
THE INTERNATIONAL PAINT & COMPOSITIONS CO., LTD.,
GROSVENOR GARDENS HOUSE, LONDON, S.W.1

Charles M. Howell

New California GM Representative

Charles M. Howell has been appointed petroleum sales engineer for the West Coast district of Detroit Diesel Engine Division, General Motors Corp. He will establish local headquarters in California but operate out of the company's petroleum industry sales office at Tulsa under the direction of Arch F. Campbell.

Natural Gasoline Engineer's Handbook

For a number of years a book called "Natural Gasoline" by Oberfell and Alden was the technical "Bible" of engineers concerned in the design and operation of natural gasoline plants. That was before distillate oil fields began to appear on the scene, and operation of plants and processes for the handling of gas and gasoline and the use of absorption became more and more complicated. The subject became too big to be covered by a rewrite of the original Oberfell and Alden book, especially since the rapid growth of cycling operations involving sampling, measurement and processing of two-phase streams under high pressure from gas-condensate wells.

The Natural Gas Association of America has, therefore, sponsored the publication of a whole new work entitled "Natural Gasoline and the Volatile Hydrocarbons" by George Granger Brown, Donald Laverne Katz, George G. Oberfell and Richard C. Alden. The work is to be in four sections covering all phases of the physical principles underlying natural gasoline and cycling operations. The first section has just been published; it covers behavior of petroleum hydrocarbons, fluid densities, vapor pressure and critical properties. This section may be ordered from the N.G.A.A., Tulsa 3, Okla. at $4.

Stanolind Enters Colombia

Through the recently organized foreign division of Stanolind Oil and Gas Co., a subsidiary of Standard Oil Co. of Indiana, concessions covering four tracts in Colombia, aggregating 200,000 hectares have been acquired. This is the first extension of Stanolind's activities beyond the borders of the United States and follows a visit to Colombia by officers of the company several months ago. Two of the tracts acquired are in the state of Magdalena near the Caribbean, and the others are on the western side of the country in the Cauca Valley area. All are in districts not previously explored. G. T. Buskirk, division geologist, is in charge of the company's exploratory work with headquarters in Bogota.

Sinclair Installs New Still

Sinclair Refining Company has completed installation at its Marcus Hook, Pa., refinery of a new catalytic cracking still capable of converting 25,000 barrels daily of charging stock into high octane motor gasoline, heating oil, thermal cracking stock and gas.

The unit is designed to permit flexibility in the yields of respective products so that the relative production of motor gasoline and household heating oil can be varied to meet seasonal demands. It will have a maximum daily gasoline producing capacity of 15,000 barrels and a maximum daily heating oil capacity of 6,000 barrels.

The gas produced will go through a polymerization plant, now under construction, in which portions will be converted into gasoline. That portion of the gas not converted to gasoline will be delivered to a neighboring utility company to augment its gas supply for domestic distribution.

In order to provide utilities for this large cracking unit, it has been necessary to install a new boiler house and a boiler feed water treating plant, to enlarge the refinery water supply plant and increase the electrical distribution system. Two vacuum stills were installed to supply charging stock to the cracking unit. To provide additional storage capacity, primarily for household heating oil and kerosene, additional land in the neighborhood has been acquired on which have been erected five 150,000-barrel tanks.

I. G. DAVIS has been appointed district manager of Mene Grande Oil Co., at Maracaibo, Venezuela, to succeed L. T. Jordan who was made general superintendent of Kuwait Oil Co. Mr. Davis has been assistant division manager at Maracaibo for the past two years. He came to Venezuela in 1935 as a geologist and geophysicist for Gulf Research and Development Co. and joined Mene Grande in 1939.

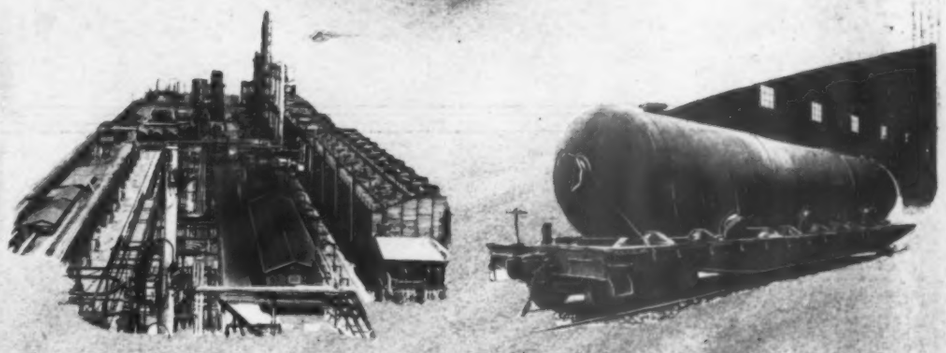
STEEL

SHAPED AND MASTERED BY CRAFTSMEN OF SKILL

becomes

THE HEART OF A REFINERY

A heart of steel pours vital oil through the veins of our universe. The refining of gas and oil is a tremendous process in which every piece of equipment, small and large, must do its job continuously, without fail. We realize our responsibility to the industry, and we are indeed proud to serve it.



We solicit your special problems for the individual consideration of our PETROLEUM ENGINEERING DEPARTMENT. Our PLANT is large and modern throughout, equipped to master the toughest jobs!

PRESSURE VESSELS STORAGE TANKS
BUBBLE TOWERS SKID TANKS
—*Special Steel Fabrications—Your Satisfaction Is Guaranteed!*

ASME — API, ASME CODES — NATIONAL BOARD INSPECTION
Write For Special Information

• PROMPT DELIVERY IS ASSURED •

3301 S. LAMAR DALLAS, TEXAS

BUTANE EQUIPMENT CO., INC.

LST's For Marine Drilling

Two former Navy LST's are undergoing conversion at Avondale Marine Ways near New Orleans. They are owned by Humble Oil & Refining Company and are to be used as mobile power units in drilling marine oil fields off the south Louisiana coast in the Gulf of Mexico. They will be completely equipped with the machinery required for drilling purposes. Quarters for crews of 59 will be provided, and the galley and refrigeration plants will be adequate for sustaining the crews for a period of at least two months.

Selects Plant Site

Garden City, Kansas, has been selected by Stanolind Oil and Gas Co. as the site for its Hydrocol plant, E. F. Bullard, president of Stanolind, announced. Soil surveys and water exploration tests will start immediately. Site preparation will begin promptly and major construction will begin in the fall. Stanolind's plant will take natural gas from the Hugoton field, some of which is not desirable for sale because of its low Btu content, and will convert it into synthetic gasoline, diesel fuel, fuel oils and chemicals. During the height of construction Stanolind engineers estimate that nearly 4,000 workers will be required on the project. Proposed completion data is January, 1950. A permanent force of about 600 will be needed to operate the plant. Many major pieces of equipment are already being fabricated and more than 200,000 tons of equipment and material will be required.

Venezuela's 1947 Production

Crude oil production in Venezuela during the month of December amounted to 38,726,300 barrels. Exports for the month were 34,989,131 barrels. Production by companies was as follows:

Company	West	East	Total
Creole	14,328,539	4,793,436	19,121,975
Mene Grande	1,956,098	4,727,954	6,684,052
Shell	10,899,280	—	10,899,280
Consolidada	—	603,359	603,359
Socony	—	925,204	925,204
Texas	194,857	186,879	381,736
S.A.P. Las Mercedes	—	2,271	2,271
B.C.O.	35,978	—	35,978
Orinoco	7,978	—	7,978
Phillips	—	60,759	60,759
Varco	—	4,008	4,008
Guasare	—	—	—
Total Barrels	27,422,730	11,303,870	38,726,600

Production for the twelve months ending December amounted to 434,643,254 barrels, an average of 1,190,800 barrels daily.

Texaco to License Synthetic Plants

Texaco Development Corp. is now prepared to license anyone within the petroleum industry to manufacture synthetic gasolines by means of the Hydrocol process, W. M. Stratford, president, has announced. The new process, Mr. Stratford said, resulted from the joint and continuing research efforts of Hydrocarbon Research, Inc., and The Texas Co. Commercial operations will begin early in 1949 at the Hydrocol plant at Brownsville, Texas, and in 1950 at the Stanolind plant at Garden City, Kansas. Each of these plants when completed will produce more than 300,000 gallons per day of synthetic gasoline.

L. C. Kemp, Jr., director of research for The Texas Company, announced that a new research center and pilot plants have been established at Montebello, Calif. Semi-commercial scale pilot plants at Montebello, capable of producing 5,000 gallons of synthetic gasoline per day, are now operating, Mr. Kemp said. Work is now under way on the conversion of heavy fuel oils and of various types of coal to synthetic fuel.

Honored by the Netherlands

R. B. Carder of the Tropical Oil Co., Bogota, Colombia, has been appointed an officer of the Order of Orange Nassau by H. M. the Queen of the Netherlands. The honor is in recognition of his services in aiding in Holland's liberation while serving as a lieutenant colonel in the British Army. Mr. Carder is the eldest son of R. A. Carder, managing director of Anglo-American Oil Co., Ltd.

New Texrope Catalog

A new 144-page indexed catalog for pre-engineered stock Texrope drives which simplifies drive selection so persons untrained in V-belt engineering can readily specify proper drives, has been announced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. In the process of development by Allis-Chalmers Texrope engineers for more than a year, the catalog is said to represent one of the most outstanding compilations of engineering data ever assembled for the industry.

German Plant Removals

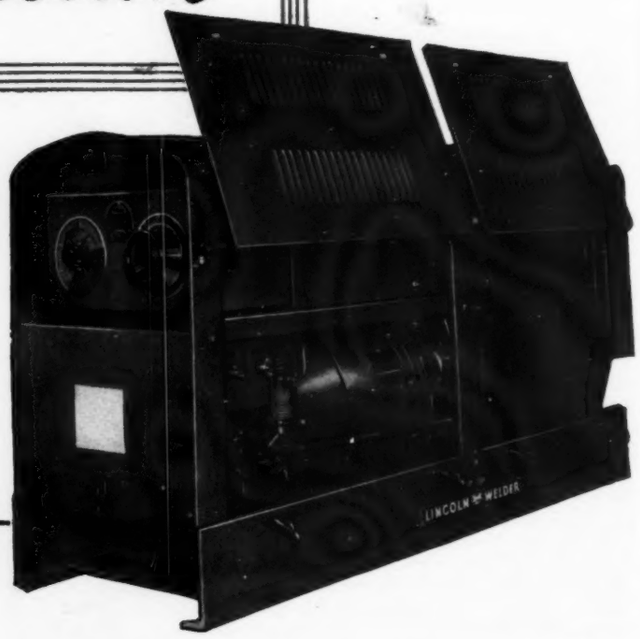
Reports from Germany state that three of the large hydrogenation plants, located in what is now the Russian zone of occupation, have been dismantled

Petrol Engined Perfection

★ LINCOLN GENERATOR WITH DUAL CONTINUOUS CONTROL

★ HEAVY INDUSTRIAL ENGINE DESIGNED FOR DEPENDABILITY

★ BRITISH MADE THROUGHOUT



LINCOLN

WORLD'S LARGEST MANUFACTURERS OF ARC WELDING EQUIPMENT AND ELECTRODES

LINCOLN ELECTRIC COMPANY LTD · Welwyn Garden City, Herts, England · Welwyn Garden 920

and moved to sites on Lake Baikal, Siberia, for re-erection. The plants involved are Politz near Stettin in East Prussia which had a monthly capacity of 430,000 barrels. Blechhammer in Silesia which had just started operation at the time of the Russian invasion, and a third near Magdeburg on the River Elbe. Together the plants had a productive capacity of about 810,000 barrels monthly.

Lion Buys Chemical Plant

Lion Oil Co. has purchased the government chemical plant near El Dorado, Ark., which it operated during the war. The chemical plant, formerly known as Ozark Ordnance Works, is one of the largest United States producers of anhydrous ammonia, ammonium nitrate fertilizer and nitrogen fertilizer solutions. Lion took over the plant for private operation under a long-term lease in 1946 and has been operating it continuously since that time.

YPF Establishes Bonuses

To stimulate greater productivity at Argentine refineries and other enterprises of the YPF, the management has instituted rewards for employees who have low records of absenteeism. Office, field and refinery employees drawing wages or salaries less than $550 (Argentine currency) a month who are not absent during the month receive a bonus of $40; those with one, two or three absences receive $30, $20 or $10. These bonuses will not apply in cases of unreported or unjustified absences.

Colombia's Oil Production

Production of crude oil in Colombia during 1947 amounted to 24,980,729 barrels, an average of 68,440 barrels daily. This represents a substantial gain over 1946 when the total production was 22,423,520 barrels, averaging 61,434 barrels daily. Exports during 1947 amounted to 19,599,600 barrels.

Julio Zumeta

Charles J. DeLay

W. F. Ellebrecht

Zumeta Heads Continental Export Division

Julio Zumeta has been appointed executive manager of exports for Continental Supply Co. at New York. He succeeds F. L. Convers, who has retired. For the past two years Mr. Zumeta has been Continental's export representative in South America.

Charles J. DeLay, long identified with the New York office, is now manager of the export division. W. F. Ellebrecht has been named Dallas export representative.

Mr. Zumeta joined Continental in 1934 after graduating from Lehigh University in industrial engineering. He was loaned to Emsco Derrick & Equipment Co., Houston, in 1939, where he became chief mechanical engineer before he joined the Army in December, 1941. He served with various units of the Mediterranean Allied Air Forces in Italy, France and Romania, and held the rank of Major when he left the Army in October, 1945, to rejoin Continental. He was export representative in South America in 1946 and 1947 with headquarters in Buenos Aires, Argentina.

Mr. DeLay spent his early life in the oil fields of West Virginia. He joined Continental in Wichita Falls in 1919 and was transferred to the New York office in 1921. Mr. Ellebrecht joined Continental in St. Louis in 1915, was transferred to the export division, New York, in 1930. In 1942 he was transferred to the Dallas sales division and the past few years has been in sales promotion work.

GEORGE ANGUS & Co LTD
ESTABLISHED 1790
OIL SEAL WORKS
NEWCASTLE UPON TYNE. 6. ENGLAND
EXPORT DIVISION:
Angus House, 7, Bury St., St. Mary Axe, London, E.C.3
AGENTS THROUGHOUT THE WORLD

Announcing...

ANGUS CUPS
NOW AVAILABLE

Angus Cups—the first high-grade Valve and Seating Cups of British manufacture—are now available to Oil Field Engineers. Produced from 'Gaco' Fabric composition, an extremely tough and wear resisting compound, with our famous 'Gaco' synthetic rubber as the bonding medium. Layers of fabric are impregnated with 'Gaco' and moulded under heavy pressure to form a tough compact composition capable of resisting the action of abrasion, crude oils and gases at high working pressures and temperatures. Years of intensive research are behind the development of Angus Cups. Supplied in three hardnesses, sizes as laid down by A.P.I. standards.
Our 'Gaco' synthetic material, which achieved a wide reputation before and during the late war as a medium for hydraulic sealing in aircraft and engineering mechanisms, is also now available for the manufacture of other products used in the Oil Industry.

GACO

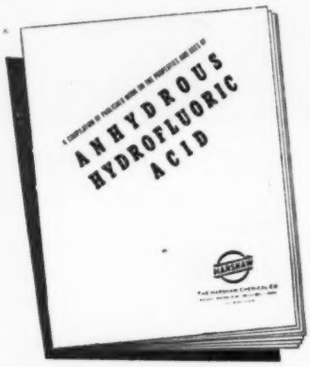
Angus Valve and Seating Cups are supplied in accordance with A.P.I. Std. No 11A

Petroleum Council of Colombia

Recent appointments to the technical staff of the Petroleum Council of Colombia include Guillermo Cordoba Borrero, formerly with the drilling department of Shell Oil Company; Marino Arce Herrera, field geologist, and Jaime Toro, expert on oil-field equipment and materials.

Pan American Conference

Representatives of 21 American republics gathered at Bogota, Colombia, on March 30 at attend the Pan American Conference assembling there. Among those attending the conference are government officials, businessmen, scientists, lawyers and economists. One of the subjects scheduled for discussion is the extent of American oil resources and the outlook for their development. This is considered to be especially important in view of the world-wide shortage of available oil supplies and the disturbed political conditions in the Eastern Hemisphere.



Write for this helpful booklet

You are not obligated

THE HARSHAW CHEMICAL CO.
1945 East 97th Street, Cleveland 6, Ohio
BRANCHES IN PRINCIPAL CITIES

Pennsylvania Petroleum

For readers who have a taste for early petroleum history, a new book entitled, "Pennsylvania Petroleum, 1750—1872," should provide much interest and entertainment. It is written by Prof. Paul H. Giddens of Allegheny College and published by the Pennsylvania Historical and Museum Commission (Titusville, Pa.; $1.75). The narrative is confined entirely to events and personalities and enterprises that figured in the Pennsylvania oil industry up to 1872. Many new documents have been discovered and are here published for the first time. From the wealth of material now available the author has made an absorbing story.

Lane-Wells Promotes Field Men

R. B. Downing has been appointed Mid-Continent division manager of Lane-Wells Co. to succeed R. B. McCullar, resigned. "Ike" Downing joined Lane-Wells in 1941 after previous experience as geologist for Barnsdall Oil Co. and as a consultant. C. L. Kirkman, assistant district superintendent at Great Bend, Kansas, succeeds Downing as division sales manager of Oklahoma City. R. H. Waggoner, Russell, Kansas, has been transferred to Great Bend to succeed Kirkman; and A. N. Downing steps up to Waggoner's old job.

L. V. Steffey has been transferred from Oklahoma City to Salem, Illinois, as district superintendent, succeeding R. G. Echols, resigned. E. C. Doane, formerly sub-district superintendent at Seminole, Okla., has been appointed to Staffey's former position; and Sidney R. Pittman, formerly an operator in Healdton, Okla., has succeeded Doane.

R. B. Downing

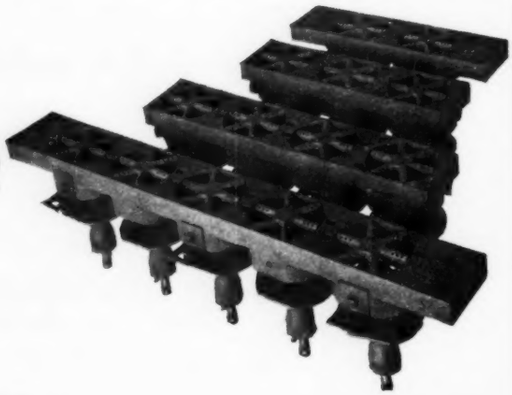
J. D. Dunigan has been promoted to district superintendent at Guymon, Okla., and Ray Edwards is now sub-district superintendent at Garden City, Kansas. In the Gulf Coast division, E. A. Radack has been moved from Laurel, Miss., to Shreveport, La., as assistant district superintendent.

Perfo-Jet Process Licensed

Under a sub-license granted by Byron Jackson Co., Perforating Guns Co. will provide the Perfo-Jet process to Gulf Coast operators and producers. The Perfo-Jet process applies the "shaped charge" principle used in the wartime Bazooka to gun perforating. New-type guns have been developed by Bryon Jackson to fire the charges. Perforating Guns Co., has its main offices in Houston, Texas.

R. E. F. S. BAMPTON has relinquished the post of chief of the fuels section of the European regional office of UNRRA and has taken up the appointment of regional oil officer, Land North Rhine/Westphalia in the British zone of Germany.

JOHN ZINK
BI-MIX
FLOOR BURNER



The Most Versatile
BURNER
For The Refining Industry

The Bi-Mix Floor Burner is so strong that the workman may walk on it. Available as single or multiple units. Sizes: 8", 10", 12" and 14" diameter spiders. This Bi-Mix burner gives an ideal heat pattern for floor firing of refinery furnaces with gas.

WRITE FOR LITERATURE

JOHN ZINK COMPANY
4401 S. Peoria **Tulsa 1, Oklahoma**

The New Brantly Rotary Drilling Handbook

The appearance of a new edition of Brantly's Rotary Drilling Handbook—the fourth—is an event of note, especially in these times when the search for oil has become more intensive and on a larger scale than ever before in the history of the industry, and in times when the costs of exploratory and development drilling have reached unparalleled peaks. In such times the oil operator and the drilling contractor surely need a friend like Brantly, who knows his way about in the problems of oil drilling as well as any, and, on the record, better than most.

In their time the three previous editions of this Rotary Drilling Handbook have reflected the fundamentals of rotary drilling in their most advanced form. On these fundamentals it is well known that Mr. Brantly (a drilling contractor himself) has left an indelible impress of his own practical genius that has been sharpened by a wide and varied experience in near and remote parts of North and South America and Asia. He was one of the pioneers of contract drilling in the difficult California fields, where the soundness of his ideas and the practicality of his devices brought fruitful results that have been numerously duplicated in other fields. The drilling fraternity has come to recognize Mr. Brantly as an author who can be depended on to offer counsel based on successful personal experience.

The present fourth edition of the Brantly Handbook shows, on an enlarged scale, the same judicious choosing and organization of the text, that has characterized the previous editions. The art of rotary drilling has not been static; time and many active minds have been turning up new and still better ideas. To make room for this new wealth of information Mr. Brantly and his collaborators have greatly enlarged the book—to 547 pages, in fact, divided into 26 chapters, a glossary, and 187 pages of formulas and reference tables. The 26 chapters cover the whole range of operations, equipment, and accessories of rotary drilling, through power plants, pumps, derricks, engines and hoists, rotary table units, feed controls, derrick equipment, lubrication, wire lines, drilling shaft, pipe and depth measurements, bits drilling fluid rotating speeds, weight on bit, instruments, directional drilling, fishing, casing and cementing, formation testing, hole sizes, safety measures, geology and formations, to methods of accounting pertaining to oil well drilling. The book is of convenient pocket size.

Like its predecessors the fourth Brantly qualifies to serve as an oil driller's bible until accumulated progress calls for a fifth.

This book may be ordered through WORLD PETROLEUM, 2 West 45th Street, New York 19, N. Y. Price $7.50 postpaid.

International Petroleum Sale

Imperial Oil Ltd. has announced that it intends to sell its holdings in International Petroleum Co. in order to obtain funds for development of Imperial's promising properties in western Canada. Imperial stockholders will be permitted to buy stock on a pro-rata basis at $9.20 (U. S.) per share. Standard Oil Co. (N. J.) has announced that it will buy the 70 percent to which it would be entitled and will exchange Jersey company stock for any other International stock which may be offered. Exchange ratio offer is three shares of Jersey for 20 of International.

ARVILLE IRVING LEVORSEN, head of the School of Mineral Sciences at Stanford University, has been named recipient of the Sidney Powers Memorial Award of the American Association of Petroleum Geologists. The award "in recognition of distinguished and outstanding contribution to, and achievements in, petroleum geology" will be conferred at the annual meeting of the A.A.P.G. in Denver. April 27.

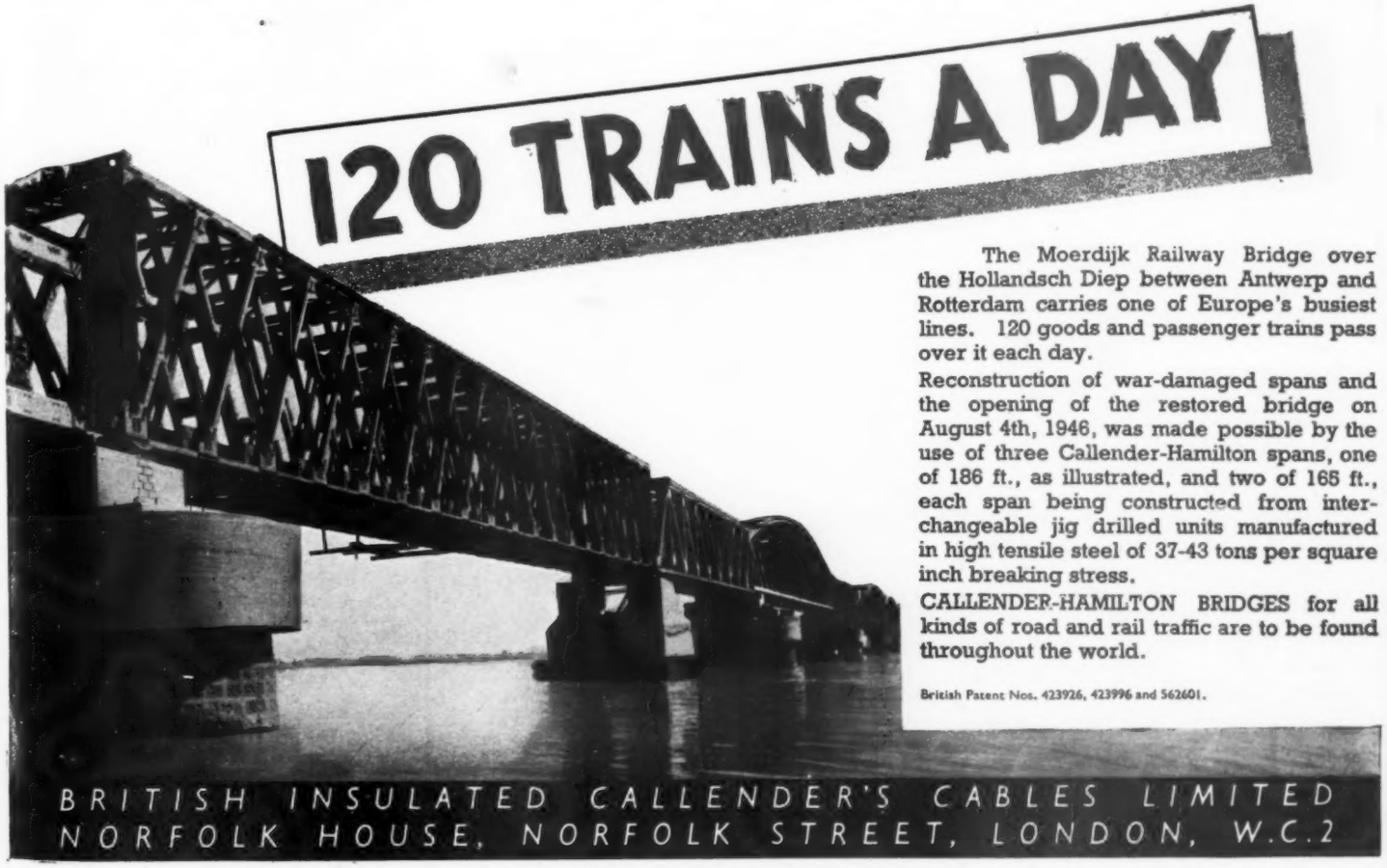
Mr. Levorsen worked in the Mid-Continent for 15 years in consulting capacities and as chief geologist for several oil-producing companies. In 1945 he went to Stanford.

HARRY LEYENDECKER has been elected vice president of Eastern States Petroleum Co., Houston, in charge of production, crude supplies and transportation. He resigned as assistant vice president of the City National Bank of Houston to accept the new position. Mr. Leyendecker entered the oil business first in 1920 with Marland Oil Co. and later served Tide Water Associated Oil Co. for 15 years.

To Build Cat Cracker

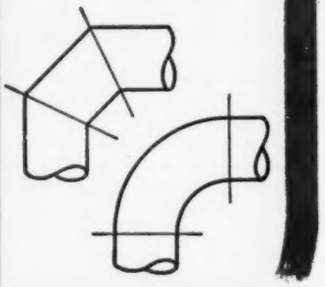
L. E. Winkler, president, Rock Island Refining Corp., Indianapolis, Indiana, has announced that his company has entered into an agreement with Universal Oil Products Company, Chicago, for the design and engineering of a fluid catalytic cracking unit which is to be installed in the Rock Island refinery at Rock Island (near Indianapolis). The Unit which Rock Island will install is to be designed for a capacity of 5,000 barrels per day of Mid-Continent gas oil at 54 percent conversion. This is essentially the same type unit which Universal designed and which has been on stream at the refinery of Aurora Gasoline Company, Detroit, since the summer of 1947.

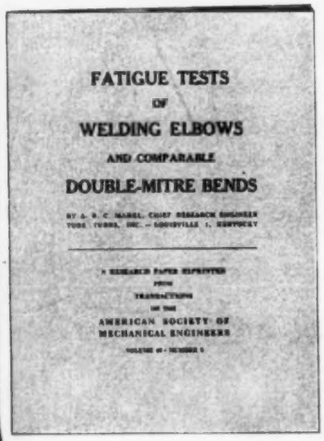
The unit for Rock Island will be so designed that it will utilize to the fullest extent the already existing thermal cracking unit and gas recovery system. Feed preparation equipment for supplying charge to the cat cracker is already in place and will be a part of the new fluid unit.


120 TRAINS A DAY
The Moerdijk Railway Bridge over the Hollandsch Diep between Antwerp and Rotterdam carries one of Europe's busiest lines. 120 goods and passenger trains pass over it each day.
Reconstruction of war-damaged spans and the opening of the restored bridge on August 4th, 1946, was made possible by the use of three Callender-Hamilton spans, one of 186 ft., as illustrated, and two of 165 ft., each span being constructed from interchangeable jig drilled units manufactured in high tensile steel of 37-43 tons per square inch breaking stress.
CALLENDER-HAMILTON BRIDGES for all kinds of road and rail traffic are to be found throughout the world.
British Patent Nos. 423926, 423996 and 562601.
BRITISH INSULATED CALLENDER'S CABLES LIMITED
NORFOLK HOUSE, NORFOLK STREET, LONDON, W.C.2

WHICH?

and Why





GET THIS BOOK

Fatigue Tests of Welding Elbows and Comparable Double-Mitre Bends: This research paper gives the authoritative pro-and-con. Analyzes effects of bending in the plane and transverse to the plane of curvature, and bending with and without internal pressure. Mail the coupon.

TUBE-TURN — *T. M. Reg. U. S. Pat. Off.*

WELDING FITTINGS AND FLANGES

District Offices at New York, Philadelphia, Pittsburgh, Detroit, Chicago, Houston, Tulsa, San Francisco, Los Angeles

Tube Turns, Inc., Dept. 4008, Louisville 1, Kentucky

Please send "Fatigue Tests" booklet.

Name.....

Position.....

Firm Name.....

Street.....

City.....*Zone*....*State*.....

S. O. Calif. to Build UOP Thermal Cracker

Standard Oil Co. of California has authorized Universal Oil Products Co. to design a two-coil thermal cracking unit with stabilizer and other auxiliaries and a Unisol unit to extract mercaptans from the cracked gasoline. Both units are to be installed at the Sandard Bakersfield, California, refinery as part of a program of expansion and modernization of that plant. The cracker is to be designed to process 9000 barrels per day of heavy oils. C. F. Braun Co. of Alhambra, California, is the general contractor.

Aids Atomic Research

A $250,000 grant for atomic research and training of nuclear scientists has been made to the Massachusetts Institute of Technology by The Texas Co. The funds will be used for long-range pure research in nuclear fission and related basic studies on the ultimate nature of matter and energy, to construct high voltage equipment of advanced design and to train scientists in nuclear theory and its application.

Liquid Fuel Conference

The Institute of Petroleum and the Institute of Fuel are to hold a joint conference on "Modern Applications of Liquid Fuels" at Birmingham University September 21-23, 1948, together with an exhibition of items related to the subjects on the program.

The general scope of the conference will be indicated in an opening address on "The Place of Liquid Fuel in the British Economy." Separate sessions, each of two and a half hours, will then be devoted to the following subjects: Diesel Engines for Power Generation and Railway Traction; Oil for Gas Making; Gas Turbines for Land and Marine Power Purposes; Agricultural Drying Processes; Fuel Oil in the Steel Industry; Fuel Oil in the Metal Industries, and Fuel Oil in the Glass and Ceramic Industries.

Shell Union Report

Shell Union Oil Company's report for 1947 lists capital expenditures of $138,431,000. Commenting on the rise in the oil industry's "cost of living," it points out that whereas $9 of investment in refinery equipment would produce a gallon of oil ten years ago, it now requires about $35 of investment to do the same job. To meet the heavy outlay for capital account $50,730,000 was taken from depreciation funds, $29,566,000 from net earnings and $55,944,000 from accumulated cash resources. As a result cash and securities declined from $135,888,000 to $79,944,000.

Net income for the year amounted to $59,874,698 equal to $4.44 per share as compared with $32,880,417 and $2.44 per share in 1946. Production, pipeline and manufacturing operations were all at a high level during the year.

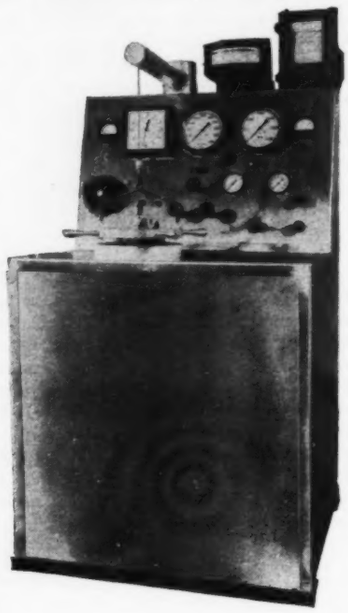
Establishes Fellowship

The Texas Company is establishing a graduate fellowship at the University of Southern California to encourage advanced studies and research in the field of chemical engineering. Its purpose will be to study fundamental problems of distillation in refinery procedure.

Pressure Reducing Valve

Mueller Steam Specialty Co., of Long Island City, New York, have produced a new Type 31 pressure regulating valve. Its outstanding features include low initial cost, internal woven Monel wire screen, stainless steel valve spring, a throttling plug type disc and a large diaphragm loaded with a long flexible spring permitting sensitive operation and wide reduced pressure ranges without changing springs. The regulator is available in semi-steel, bronze or other special alloy bodies with Naval bronze, stainless steel or bronze or stainless steel laminated diaphragms.

R. S. SUPER-PRESSURE CONSISTOMETER

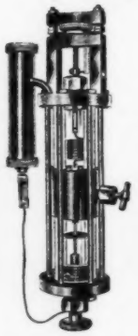


for TESTING OIL WELL CEMENT SLURRIES

The consistometer is designed for testing cement slurries under elevated pressures and temperatures. This equipment can be used for studying the pumpability of different kinds of cement slurries as well as studying the action of cement slurries under different conditions encountered in actual field practice. The instrument is calibrated in poises and is suitable for pressures up to 20,000 P.S.I. and temperatures of 350°F. The instrument can be used for testing cement slurries under simulated well conditions equivalent to depths of 18,000 to 20,000 feet. For operation the equipment requires electric current of 110 volts, 60 cycles A.C. and compressed air supply of 100 P.S.I.

PULSAMETER

A Pulsation Measuring Instrument



The "Pulsameter" is an instrument for measuring the differential pulsation amplitude across an orifice meter. Where orifice meters are located near Compressor stations, pulsations are usually present. The magnitude of these pulsations depends on local conditions—number and kind of compressors, piping layout, etc. The "Pulsameter" can be connected to the orifice meter gauge piping and for the condition of measurement the maximum differential pulsation amplitude and recorded differential reading on the orifice meter are determined. From this information the accuracy of the orifice meter under the pulsating condition is indicated.

This testing equipment is used in connection with gas measurement by orifice meter.

"Complete Line of Scientific Laboratory Equipment"

WRITE FOR CATALOG NO. 30-B

The REFINERY SUPPLY CO.

Main Office and Plant

621 E. 4th St. Tulsa 3, Oklahoma

Houston Office Temporarily Discontinued